PROCEEDINGS BOOK OF THE 7th

ADVANCED ENGINEERING DAYS

9 July 2023 / MERSIN, TURKIYE

International Engineering Symposium

Congress Chairman

PROF. DR. MURAT YAKAR

http://aed.mersin.edu.tr/

ISBN: 978-605-72800-5-3

7th Advanced Engineering Symposium

I would like to thank all of the contributing authors and reviewers to the 7th Advanced Engineering Days (AED) Symposium, on 9 July 2023. In this international symposium there are 57 papers. 28 of them are from Türkiye and the rest are from 9 different countries. We would like to see you in the 8th AED.

Best regards

Prof. Dr. Murat YAKAR

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The effect of microbiota in mood disorders: Utilization of probiotics as a therapeutical approach

Hazal Altundağ [*1], **Furkan Ayaz** [1,2]

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Cite this study: Altundağ, H., & Ayaz, F. (2023). The effect of microbiota in mood disorders: Utilization of probiotics as a therapeutical approach. Advanced Engineering Days, 7, 1-3

Keywords
Anxiety
Gut microbiota
Probiotic
Microorganism

Abstract

There are trillions of microorganisms in the human body. All microbial communities in the gastrointestinal tract are intestinal microbiota**.** The main task of this community can be counted as; defense against diseases, digestion of food, etc. Moreover, they have effect on the human mood and behaviors. In addition to its basic functions, the brain-gut relationship, which has been the subject of many studies recently, draws attention. Based on this relationship, it is noteworthy that the microbiota disorder causes anxiety and depression, and the use of probiotics seems as a promising solution. In this proceeding review, we will be discussing this theme more in depth.

Introduction

Trillions of beneficial and harmful bacteria live in the human body. This community is called the gut microbiota, located in the gastrointestinal system. This community plays a role in physiological development and communication with the brain, apart from the basic functions in the host such as defense against diseases and digestion of nutrients.

The development process of the intestinal microbiota begins with birth and continues to develop after birth under the influence of environmental factors [1,2]. The beginning of the developmental process is the moment of birth. As a result of different studies, the microbiota formed after vaginal birth and cesarean delivery are different from each other. It was observed that some bacteria were absent in the cesarean section and Lactobacillus species were found to be low. Intestinal microbiota is similar to the microbiota of the vagina in vaginal delivery and to the microorganism's similar hospital environment and mother skin in cesarean delivery [3].

This fascinating structure works in great harmony with our body and is in communication with many structures in our body. Let's move on through mammals: The nervous system in mammals is examined under two headings: central nervous system, and peripheral nervous system. The enteric nervous system connection of the central nervous system occurs with the sympathetic and parasympathetic nerves. The sympathetic and parasympathetic nerves, after leaving the hindbrain, synapse with the gastrointestinal tract. The vagus nerve is an example of this [4].

The communication pathway between the brain and the gut splits into two: The autonomic nervous system in the spinal cord, the enteric nervous system in the gut, and the vagus nerve play a role in bidirectional transmission. The first transmission pathway is the reciprocal communication between the autonomic nervous system in the spinal cord and the vagus nerve. Second, it is the transmission pathway between the autonomic nervous system in the spinal cord, the enteric nervous system in the intestine, and the vagus nerve [5].

Vagus nerve is important in brain-gut relationship. In a study, the role of the vagus nerve in transmission and the effectiveness of the bacteria were investigated by using Lactobacillus rhamnosus bacteria. As a result of the research; It has been determined that the vagus nerve has an important place in transmission and L.rhamnosus bacteria reduces anxiety in mice [6].

In case of disruption of this structure, which can communicate with the human brain in two directions, various disorders are observed. One of these is mood disorders that negatively affect the quality of life of many people.

There are many studies proving that the gut microbiota is effective on human psychology. High levels of mood disorders such as depression-anxiety were observed in people with bowel disease. There were also differences in the gut microbiota of people with this mood disorder [7]. In 2002, the WHO and FAO recognized probiotics as live microorganisms that, when administered in proper ways and amounts, enable a health benefit to the host [8]. The use of probiotics regulates the microbial balance. The two most important members of the probiotic group of microorganisms are Bifidobacterium and Lactobacillus species [9].

Material and Method

Let's examine a study that deals with the effect of gut microbiota on psychological disorders and the results of using psychobiotics for treatment; The aim of this study was to have information about the psychological effect of the formulation containing psychobiotics (PF) in rats and humans. In the study, rats were divided into three groups and subjected to commonly used tests to obtain information about their anxiety and depression levels before the study. The treatment method was applied to each group for 14 days, and at the end of the 14th day, the same tests were repeated and the results were obtained.

In the same study; 55 people participated voluntarily. Volunteers were subjected to certain tests before the study. Participating volunteers were divided into 2 groups and exposed to probiotic formulation (PF) or placebo formulation (PL) treatment for 30 days. At the end of 30 days, the tests performed before the study were repeated and the results were obtained [12].

The effects of psychobiotics on psychological disorders show promising results for the future. As a result of clinical and pre-clinical studies, probiotic formulations; It has been proven to reduce anxiety and depression in both animals and volunteer humans. As a result of the tests, it was noted that there was a memory improvement and a strengthening in learning in rats at the pre-clinical stage [12].

Results

The effects of psychobiotics on psychological disorders show promising results for the future. As a result of clinical and pre-clinical studies, probiotic formulations have been proven to reduce anxiety and depression in animals and humans participating in the experiment. As a result of the tests, it was noted that there was a memory improvement and a strengthening in learning in rats at the pre-clinical stage [12].

Conclusion

New microorganism species should be discovered and new formulations should be prepared for use in different probiotic formulations. Pre-clinical and clinical studies should be increased and formulations comparable to antidepressant drugs should be obtained.

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Molecular docking: A powerful tool for predicting protein-ligand interactions

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Cite this study: Korkmaz, T. B., & Ayaz, F. (2023). Molecular docking: A powerful tool for predicting protein-ligand interactions. Advanced Engineering Days, 7, 4-6

Keywords
Molecular docking
Computational biology
Therapeutic development
Molecular interactions

Abstract

Molecular docking is a computational method used in molecular biology, structural biology and therapeutic discovery to predict how candidate molecules bind with target molecules. While predicting the binding patterns and conformations of the molecules, hardware, software, algorithm, molecule databases and models are widely used. Molecular docking processes consist of the generation and analysis of different possible conformations and orientations of the ligand within the binding site of the receptor/target. The goal is to predict the most favorable binding position or configuration, as well as the strength of the binding affinity between the ligand and receptor. The key elements of molecular docking consist of molecule preparations and using proper scoring parameters. With the help of previous knowledge and advancing technology, it is possible to expand diversity of potent therapeutics with low cost. In this proceeding review, we will focus on molecular docking as a powerful tool to predict protein-ligand interactions.

Introduction

Concept of the molecular docking is trying to determine the affinity between ligand and its receptor by using computational methods [1]. Molecular docking is the most popular SBDD (Structure Based Drug Design) method [2]. Foreseeing the binding type, binding degree and binding sites between molecules helps drug discovery and development area significantly. At first this technique designed to be used between ligand and protein which are small molecule and target molecule but in the last ten years protein-protein docking, ligand-nucleic acid docking and protein-nucleic acid-ligand docking concepts are highly popular with the growing interest in area and because of the developments of computational methods [2].

The most important elements of molecular docking include sampling and scoring [1]. Sampling represents prediction of the conformation of the ligand and its orientation and position together with the protein binding site. Scoring represents determining the quality of the binding and interactions between those molecules [2].

Molecular docking procedure basically includes these 4 steps:

1. Target selection and preparation: Target structure could be detected experimentally with using X-ray crystallography or NMR (nuclear magnetic resonance) spectroscopy ideally [3]. In some cases, target structure can be modeled by using 3D modeling programs. The structure model should be prepared in good quality and well tested with specialized software [3]. While molecules binding, the bond between them can be affected by other factors such as water molecules and side chains [2, 3]. So, removing those components till the target becomes biologically active and stable is as important as preparing the main structure [3].

2. Ligand selection and preparation: Ligand selection depends on the aim of the study. The information and structure about the molecule can be acquired from many different databases on the other hand it can be modeled by using 3D modeling programs [3]. Ligands can be bind with various types of molecules so eliminating by filtering the molecules that ligand may has affinity is important for the success of the procedure.

3. Binding/Docking: When ligand is bound to the active site of the receptor, the docking is completed. Investigating and detecting the interactions between molecules is the important step of this procedure [2, 3].

4. Analyzing Docking: The generated dockings are visualized and ranked based on their predicted binding affinity or binding energy scores. The scoring function quantitatively evaluates the strength of the ligand-receptor interaction, helping identify the most suitable binding for the aim of the study [3].

There are various of molecular docking software that can be used for predicting favorable fittings within the molecules [4]. They can be classified as ''Rigid-docking'' software which refers when both ligand and receptor are considered as rigid bodies and the fitting pattern is suited for ''lock and key'' model; ''Flexible-rigid docking'' softwares which refers when ligand is flexible and receptor is rigid and the fitting pattern is suited to ''induced fit'' model partially; and lastly ''Flexible-docking'' software when both ligand and receptor considered as flexible/soft bodies and the fitting pattern is suited to ''induced fit'' model (Table 1) [4, 5].

Table 1. Classification of molecular docking software and their main properties (adapted from [3])

Rigid Docking Software	Flexible-Rigid Docking Software	Flexible Docking Software
Early method, can be applied for macromolecules	Widely used, more reliable than rigid model	The most reliable, requires much more calculation
Only positions can be changed	Receptor molecules conformation is fixed	Conformation of the ligand and receptor is highly flexible
Rigidity does not allow to spatial shapes	Conformation of the ligands and small molecules is flexible	Software and hardware for accuracy and calculation are exceptionally needed

Results and Discussion

Molecular docking is a computational technique used in the field of molecular biology and drug discovery. It involves predicting the proper orientation or binding mode of a ligand within a target receptor to form a stable complex. With molecular docking softwares, it is possible to find and analyze the most suitable binding between the molecules with the help of specific algorithms [4].

Scientist from İstanbul University published a study which they performed molecular dynamic and molecular docking tests on the L-Glycyl-L-Glutamic Acid Dipeptide (Gly-Glu-dipeptide) by using suitable docking software. In some neurodegenerative diseases such as Alzeimer's Disease, this molecule plays an important role in preventing neuronal degeneration with its anti-apoptotic behavior. Firstly, with the help of molecular dynamic calculations, they explored the conformational variation of the dipeptide molecule then they determined and analyzed the most stable 3D structure possibly. Molecular docking procedure applied for Caspase 3 and dipeptide. As a result of molecular docking dipeptide linked to the Caspase 3's active site and showed the stability degree and locations of the bonding. Lastly, scientist tried to determine the drug ability of the dipeptide by using specialized software and calculations. As a result, they reported that L-Glycyl-L-Glutamic Acid Dipeptide could be an active drug candidate for Alzeimer's Disease [1].

In another study, scientists generated and reported various of DNA gyrase inhibitor candidates as an antibacterial treatment. DNA gyrase is a bacteria originated enzyme which unvinds bacterial DNA. With the help of software and calculations, scientists investigated some binding patterns with the known inhibitors of the enzyme. They observed how inhibitors and enzyme exchange hydrogen bonds and the necessity of the lipophilic interactions during the binding. With those information and models, scientist revealed a various number of molecules which fit this binding model and can be potent inhibitor for the DNA gyrase enzyme [5, 6].

Scientists from Ahmadu Bello University studied binding patterns between 2,4-Disubstitued Quiloline derivatives and Lipoate Protein B (LipB) by using molecular docking tools. LipB protein is the *Mycobacterium tuberculosis* receptor and has a potential as a target for anti-tuberculosis treatments [7]. Tuberculosis still needs better treatment method since current vaccines such as BCG is not efficient enough. For this study LipB protein selected as a target antigen and binding patterns and affinities of derivatives detected and compared with eachother and other known drugs. They reported that Ligand 8 and Ligand 17 were able to bind LipB target better than other derivatives and known drugs and they have a potential to be more suitable anti-tuberculosis drug candidates [7].

As another example of molecular docking study, scientist tried to find biopolymer adjuvant carriers for treatment of Dengue disease. Dengue disease is caused by dengue virus (DENV) and its incidence is highly increased in the last decade. They used monomer units of CS (chitosan), PVP (polyvinylprrolidone), and CS/TPP/CS [chitosan-tripylphosphate-chitosan) as ligands and E protein of the virus as a target. With the help of suitable softwares and algorithms, molecular docking patterns and affinities detected. They reported that each biopolymer has great affinity to E protein and they can be used as potent adjuvants for dengue virus vaccines [3].

Conclusion

Molecular docking has emerged as a pivotal tool in the field of computational drug discovery [4]. The molecular docking concept allows for efficient screening of compound libraries, coherent optimization of molecules and comprehensive understanding of ligand-target interactions [2]. As computational methods continue to develop and our knowledge of protein structures and dynamics expands [4,5], molecular docking plays an important role in the development of novel therapeutics such as inhibitors, adjuvants, blockers or catalysts etc; benefiting patients worldwide at last. On the other hand, there is still a room for progress in molecule libraries, algorithms and more accessible hardware and software for the molecular docking studies.

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Roles and activities of myeloid-derived suppressor cells (MDSC)

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Cite this study: Servi, H., & Ayaz, F. (2023). Roles and activities of myeloid-derived suppressor cells (MDSC). Advanced Engineering Days, 7, 7-8

Keywords
MDSC
PMN-MDSC
M-MDSC
Tumor
Cancer

Abstract

The term "myeloid-derived suppressor cells" (MDSC) refers to a diverse community of primarily immature myeloid cells that are pathologically activated and have strong immunosuppressive properties. They are in charge of the immune response in a variety of pathological conditions and are intimately connected to subpar clinical results in the progression of cancer. Depending on the expression of cell surface markers, they are divided into three groups: polymorphonuclear (PMN-MDSC), monocyte (M-MDSC), and early MDSCs. PMN-MDSCs in this group share morphological and phenotype features with neutrophils, while M-MDSCs are characterized by their similarity to monocytes and high plasticity. MDSCs enter the circulation before they complete their maturation, as a result of stimulation of the bone marrow by different growth factors, chemokines, and cytokines, which are caused by inflammation, in anti-tumor immune responses. In this study, we will review the functions and activities of MDSCs.

Introduction

Due to inflammation, many elements of the natural immune system around the tumor exist. These elements are; mast cells, dendritic cells, neutrophils, macrophages, natural killer cells (NK), and MDSCs [1]. They are directly linked to poor clinical outcomes in the development of cancer and are in control of the immune response in a number of pathological conditions [2].

MDSCs are high in humans and mice with different pathological conditions. MDSCs have functions such as potent immunosuppression. They also act as an important negative regulator of immune response in cancer and chronic inflammation [3]. The source of this evil role in cancer disease is the promotion of tumor angiogenesis, drug resistance, immune suppression, and tumor metastases. Tumor metastasis contain the physical migration of cancer cells from the primary tumor to distant organs and the subsequent process of cancer colonization in the organ. Although the ability of MDSCs to create a microenvironment in distant organs before metastasis is often unknown, it has been proven to have an important effect on metastasis formation. They are directly linked to poor clinical outcomes in the development of cancer and are in control of the immune response in a number of pathological disorders [4].

Granulocyte/polymorphonuclear MDSCs (PMN-MDSCs) and monocytic MDSCs (M-MDSCs), which are categorized based on their granulocyte or monocytic myeloid cell lineage, respectively, are the two major groups of MDSCs in humans and mice. Additionally, there are early MDSCs, a small subset of myeloid precursors with characteristics unique to MDSCs in people. This group shows a potent immunosuppressive property. It is more often composed of precursors and myeloid progenitors [5].

The initiation of the development of MDSCs occurs when HSCs in the bone marrow differentiate into CMPs and CMPs into GMPs. This process is controlled by the growth factors G-CSF, SCF, GMCSD, and MCF. GMPs differentiate into myeloblasts (myeloblasts, MB) and macrophage/dendritic cell progenitors (macrophage/dendritic cell progenitors, MDP). With the presence of VEGF, IL-1 β and IL-6, MBs are involved in GMDSC; MDPs differentiate into M-MDSC [6].

Their ability to inhibit immune reactions in reactions with B cells, natural killer (NK) cells,and T cells is the most basic feature that defines MDSCs. PMN-MDSC and M-MDSC, are the basic biochemical features in the suppression of immune responses; They share induction of ER stress, S100A8/A9 expression, an activator of transcription 3 (STAT3) expression, upregulation of arginase 1 expression and signal transducer. Additionally, they possess special qualities that have an impact on their capacity to control various features of immune reactions. For instance, while PMN-MDSCs use prostaglandin E2 (PGE2), reactive oxygen species (ROS), peroxynitrite and arginase 1; M-MDSC uses the expression of immune regulatory molecules such as PDL1 and immunosuppressive cytokines such as TGFβ, nitric oxide and IL-10 [5].

Reactive oxygen species (ROS) production by MDSCs is dependent on oxidase (NOX_2) and nicotinamide adenine nucleotide phosphate (NADPH) activity, which is regulated by the transcription factor STAT3 and greatly enhanced by antigen presentation to T cells. On the contrary, the binding of integrins such as CD29, CD11b, and CD18, tumor-derived factors such as Platellet-derived growth factor (PDGF), TGF-β, IL-10, IL-6, and GM-CSF also increase ROS production [1].

Tumor cell death, IL-13, IL-4, TGF-β, TLR released from activated T cells, and IFN-γ ligands cause MDSCs to be activated for suppression. STAT1 and STAT6 pathways, which act as signal transducers and transcription activators, play a leading role here. Tumor-derived TGF-β acts as a regulator of neutrophil polarization and MDSC accumulation [1].

Results

MDSCs are involved in various processes in the regulation of immunity in autoimmune diseases, infection, and similar diseases, especially in cancer and chronic inflammation [7]. By preventing T and natural killer cell growth and operation, MDSCs also suppress antitumor immunity. Thus, they support the development of tumors by making a significant contribution to immune suppression [8].

Conclusion

MDSCs have reached an important point in tumor immunology today. A better understanding of their biological roles may be possible with the development of methods that selectively target these cells. Additionally, identifying particular markers of these cells is necessary for a better comprehension of the molecular processes underlying the development of these cells [9]. The beneficial effects of altering the biology and function of MDSCs have been observed through preclinical and clinical studies to date. As a result of all these, it is thought that immunotherapeutic strategies such as targeting MDSCs, immune checkpoint inhibition, or strengthening the immune system by means such as vaccination may be promising in the future [10].

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Different types, pathogenesis and cytokine network of Psoriasis

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Cite this study: Türkben, H., & Ayaz, F. (2023). Different types, pathogenesis and cytokine network of Psoriasis. Advanced Engineering Days, 7, 9-11

Keywords
Psoriasis
Cytokine
Keratinocyte cells
Hyperproliferation

Abstract

Psoriasis is an autoimmune and dermatological disease characterized by high differentiation of keratinocyte cells, which are found in 5% of the skin. In the pathogenesis of psoriasis, functional changes in the HLA-Cw susceptibility allele and dendritic cells, which play an important role in cytokine secretion, helper T cells and keratinocytes are involved. With the alteration of this susceptibility allele, psoriasis is categorized in 7 different phenotypes, according to the sites of involvement. The treatment of the disease is possible in different ways such as topical, systemic and phototherapy. In this review proceeding, we will focus on different types and pathogenesis of psoriasis.

Introduction

Psoriasis (psoriasis) is an autoimmune dermatological disease characterized by T cells-mediated hyperproliferation of keratinocyte cells, which form the outermost layer of the skin, and the migration of CD8+ cells, which are inflammatory T cells, to the epidermis. Although it is a disease that can be seen at any age, it is more common in individuals between the ages of 15-30 [1].

Psoriasis occurs in two types. The first is type 1 psoriasis, which has a family history, occurs before age 40, is based on a genetic basis, and is associated with the HLA-Cw gene. Approximately two-thirds of current psoriasis patients are associated with the HLA-Cw allele. Type 2 psoriasis, on the other hand, is not genetically based, does not have a family history, and is not associated with the HLA-Cw gene, usually appearing before the age of 40 [1].

Results

Psoriasis can have different morphologies and involvement in different parts of the body [1].

1. Plaque type
2. Guttate type
3. Inverted type
4. Pustular type
5. Erythrodermic type
6. Nail type
7. Psoriatic arthritis

Plaque Type Psoriasis

It is the most common type of psoriasis. It is also known as Psoraisis vulgaris. Approximately 90% of patients have the chronic plaque type. It is usually located in the extensors of the extremities [2].

It shows involvement in the knees, elbows, scalp, trunk, belly and back. Psoratic lesions are generally observed in a punctate structure. The classic manifestation of scaly pruritus is its limited, sharply defined, erythematous, silvery color. Although these plaques are small and oval, they can merge and form larger lesions over time. These spots are characterized by oval large scales. Bleeding is seen in these spots after a while [2].

Reverse Psoriasis

It is also known as inverse psoriasis, inverse psoriasis, intertriginous, and flexural. The areas where this type of psoriasis is involved in the body are generally the genital areas, under the breasts, armpits, inguinal folds, and body folds. Psoriatic lesions are generally better circumscribed than plaque psoriasis and include rashes in the form of mild, thin scaly erythematous patches [3].

Guttat Type Psoriasis

Small but scaly erythematous papules are observed in guttate psoriasis. One of the main factors in the formation of this type of disease is streptococcal throat infection. Approximately two-thirds of small scattered papules, which usually occur during adolescence, turn into plaque-type lesions in the future. These rashes are also called drop-like papillae [4].

Erythrodermic Psoriasis

Erythrodermic psoriasis is a type of acute type and rare psoriasis that requires immediate intervention, which occurs when almost the entire body surface is inflamed and erythematous. It is seen in approximately 1%-3% of existing psoriasis patients. It starts with large rashes on the skin. In the later stages of the disease, these large rashes are replaced by dryness, scaling, dandruff and dry rashes [5].

Pustular Psoriasis

The papules in pustular psoriasis are tiny and consist of non-infectious tissue. It is one of the rare and deadly types of psoriasis. It is examined in two types: generalized and localized according to the area where they show involvement. In generalized pustular psoriasis, the entire body is covered with pus but non-infectious vesicles. In localized pustular psoriasis, rashes of approximately 2 mm in width occur on the skin, and these rashes have the potential to recur [6].

Nail Psoriasis

Nail involvement is seen in approximately 80% of individuals with psoriasis. These involvements, which can be to the fingernails and toenails, are usually more common in the fingernails. Involvement usually occurs in the nail bed or nail matrix. As a result of involvement, it may result in functional changes such as a color change in nails, subungual hyperkeratosis, onycloz, tissue formation under the skin, subnail hemorrhages, color changes/whitening of the nail plate and separation of the nail from the skin [7].

Psoriatic Arthritis

Psoriasis with joint involvement is also known as psoriatic arthritis. Joint involvement is seen in approximately 20% of psoriasis patients. It can also be considered as an inflammatory form of arthritis disease. It usually occurs in joint areas such as hips, knees, and elbows [8].

Pathogenesis of Psoriasis

There are 4 main risk factors for the formation of psoriasis.

1. Enlargement of papillary capillaries
2. Inflammation caused by migration of polymorphonuclear leukocytes to the epidermis layer
3. Hyperproliferation of keratinocyte cells forming the epidermis layer
4. Keratinocyte cells lose their granular structure and undergo an epidermal change

Functional changes in the HLA-Cw6 allele, which is one of the human leukocyte antigens, is one of the main gene changes in the formation of psoriasis. Psoriasis is the only chronic and inflammatory disease characterized by HLA-C. Identification of the phenotypic change in this allele resulted from detailed genetic mapping of the MHC

class I molecule. PSORS1 locus, located on the 6th chromosome of individuals with psoriasis, is known as the susceptibility locus that is effective in the formation of the disease [9].

Cytokine in Psoriasis

IFN-γ and TNF-α can form central cytokines in the pathogenesis of psoriasis. Along with dendritic cells, keratinocyte cells can also produce cytokines. However, IFN-γ and TNF-α also produce many cytokines and chemokines by stimulating keratinocyte cells. For example; they encourage the production of IL6, IL7, IL8, IL12, IL15, IL18, and growth factors from interferons [10].

Considering the lesions in psoriasis, there are major cytokine producers. Chief among these are dendritic cells (DC), CD4+, CD8+, keratinocytes, and helper T cells (Thl) [10].

For example, IL-15 can be produced by both keratinocyte cells and dendritic cells. In addition, CD8+ and CD4+ cells can also produce IFN-γ. IL7, IL12, and IL15 cytokines play a role in the development of CD8+ cells. The IL12 cytokine released from dendritic cells works synergistically while providing the homeostatic balance of CD4+ and CD8+ cells, and contributing to the development of dendritic cells again [10].

Discussion

The main risk factors in the formation of psoriasis are hyperproliferation of keratinocyte cells and functional changes in the HLA susceptibility gene. Psoriasis is observed in almost every part of the body, in different phenotypes, and in different involvement areas. In addition to the risk factors involved in the formation of the disease, cytokines released from keratinocyte cells, dendritic cells, and helper T cells play a major role. The use of drugs that suppress the immune system in the treatment of psoriasis is available, but it is not common. Future studies should progress by focusing on photodynamic therapy methods as well as topical drug treatments used in psoriasis.

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Goiter disease in a nutshell

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Cite this study: Çelik, B., & Furkan, A. (2023). Goiter disease in a nutshell. Advanced Engineering Days, 7, 12-14

Keywords
Thyroid
Goiter
Diffuse goiter
Nodular goiter

Abstract

The disease caused by the enlargement and swelling of the thyroid gland is called goiter disease. Environmental and genetic risk factors affect the formation of the goiter disease. There are factors such as iodine deficiency, selenium deficiency, genetics, anemia, smoking and excessive secretion of TSH hormone in the pituitary gland, factors such as age and gender should also be considered in the formation of goiter. Goiter disease is basically examined in two ways; diffuse goiter and nodular goiter. Diffuse goiter, also called simple goiter, is swelling of the thyroid gland. Nodular goiter is the formation of oval masses in the thyroid gland. In both types of goiter, first of all, increases or decreases in free T3-T4 and TSH levels are taken into account by the biochemical methods. In diffuse goiter, drug therapy or, although very rarely, surgical methods are applied. In nodular goiter, benign and malignant determinations are made about the nodule structure by the radiological methods. Radioactive iodine treatment is applied in addition to the surgical methods in nodular goiter. This short review study has touched focuses on the pathogenesis of goiter disease, treatment approaches and different types of goiter and aims to explain them.

Introduction

The disease caused by the enlargement and swelling of the thyroid gland is called goiter [1]. Although goiter is the most common disease of endochronology, it is called subclinical hypothyroidism [2]. Iodine deficiency affects every age group, starting from the fetus. Goiter disease occurs due to insufficient iodine intake in these age groups [2]. Goiter occurs when serum free thyroid hormone is at a normal level but TSH hormone is high [1]. Iodine deficiency, selenium deficiency, genetics, anemia, smoking, and excessive secretion of TSH hormone by the pituitary gland are the factors affecting goiter. and symptoms such asmanifest itself as pain [2]. Goiter disease is examined in two different ways as diffuse goiter and nodular goiter [1,2].

While diffuse goiter disease causes enlargement of the thyroid gland, nodule formation is also observed. However, nodule formation is not observed in every diffuse goiter disease. If there is no diffuse goiter nodule formation and hyperthyroidism, it is called euthyroid goiter [4]. Euthyroid goiter is examined in two ways as sporadic and endemic. Endemic goiter is bilateral or unilateral enlargement of the thyroid gland. Sporadic goiter, on the other hand, is an enlargement of the thyroid gland that develops outside the endemic region [5]. It is thought that genetic predisposition is more important than other factors in diffuse goiter [4]. Some studies have provided the mapping of the Xp22 chromosome region, which is associated with the dominant form of enlargement of the thyroid gland for clonal reasons. According to this thyroid physiology, they are important candidate genes for thyroglobulin, thyroid peroxidase, Na^+ / I^- symporters, pendrin gene and thyroid stimulating hormone receptor [5,6].

In nodular goiter, round mass formation in different sizes is observed in the thyroid gland. In the first step evaluation of nodules, benign and malignant determinations are made [2,3]. TSH measurement and thyroid ultrasound are observed during primary care evaluation [3]. As a result of these measurements, thyroid fine needle

aspiration biopsy is performed in the second step. In nodular goiter, the forms of cold, hot and warm nodules can be found simultaneously in the same thyroid gland [3,5].

Activation of thyroid stimulating hormone receptors in warm thyroid nodules results in stimulation of adenyl cyclase via the Gsα protein [5,6]. At higher TSH concentration, the phospholipase C cascade has been shown to be active through Gpα [6]. However, some studies focus on the cAMP pathway of TSH signaling. As a result of these studies, it has been proven that the increase in cAMP is effective on goiter [3,5,6].

NIS (Na^+ / I^- symporters) is responsible for the active transport of thyroid follicles [6].

It was observed that the expression levels of Na^+ / I^- symporter decreased in cold thyroid nodules [6].

It is thought that somatic mutations in genes involved in the transport of iodine affect nodular goiter. However, studies have not yet observed mutations in thyroid peroxidase, Na^+ / I^- symporter and thyroid-specific oxidase genes [5,6].

The appearance outcome of goiter due to iodine deficiency in the blood is low T4, normal or high T3 and close to the upper limit of TSH [7]. Depending on these factors levels is result, the examinations are it is followed by Direct X-ray, Thyroid Ultrasonography (USG), Color Doppler USG, Computed Tomography, Magnetic Resonance Imaging and Thyroid Scintigraphy [7].

Levothyroxine suppression therapy can be used in the treatment of diffuse goiter. Levothyroxine is taken by mouth or given by intravenous injection. However, radioactive iodine treatment can be applied to shrink the thyroid gland in patients who require surgery and cannot be operated [7,8].

When diagnosing nodular goiter, biochemical tests are based on serum TSH values. In fine needle aspiration biopsy, benign and malignant detection of the nodule is possibly made.

Treatment methods include antithyroid drug therapy, RAIT and surgical treatment [8,9].

To evaluate the effects of factors such as gender, age, diameter of the nodule, cystic and solid morphological features, use of antithyroid drugs and the dose of radioactive iodine treatment on the treatment results of patients who received radioactive iodine treatment [7,8]. In radioactive iodine treatment, a single capsule and liquid reconstituted capsule is applied to the patients in the form. The capsule is transmitted to the thyroid gland by the blood circulation, and thanks to effective radiation, it causes the thyroid tissue to shrink [8,9].

Biochemical methods are carried out in 2 stages. First, thyroid function tests find the connection between serum thyroid and TSH hormone. Upon the connection between the hormone and the thyroid gland, the TSH hormone is intervened. Any change to the TSH hormone can give positive great results. The most important method in the diagnosis of diffuse goiter or nodular goiter is the measurement of TSH hormone. With this diagnostic method, it is monitored which autoantibody is associated with thyroid disorders. While applying all these treatment methods, conditions such as the age, genetic predispositions and living standards of the patients are also taken into account [9-11].

Discussion

Graves' disease is among the causes of goiter. Graves' disease is in the group of autoimmune diseases. The immune system of the person produces the protein called thyroid stimulating immunoglobulin. The TSI protein stimulates the thyroid gland and causes the thyroid gland to enlarge. As a result, Graves' disease causes goiter formation and hyperthyroidism [7,10].

In a study conducted in the treatment of goiter disease; aAntioxidant vitamins, selenium and erythrocyte glutathione peroxidase levels were determined in the serum of diagnosed patients. As a result of this study, a decrease was observed in the vitamin and selenium levels of the patient with goiter, while no change in erythrocyte glutathione peroxidase was observed [7,8,10].

Conclusion

Goiter is the most common disease of endochronology. The incidence of goitre disease varies according to age, gender and the region of residence. A goiter patient can have one of the different types, such as hyperthyroid, hypothyroid, or euthyroid. The incidence of goiter in women is 30% higher than in men. The frequency of goiter in Turkey varies between 5% and 56%, depending on environmental conditions. Its incidence is higher in endemic regions with iodine deficiency. Studies have also proven that 39% of women live in regions with iodine deficiency due to genetics, and 82% of women live in regions where iodine is taken regularly [9,10].

In some studies, on nodular goiter, it is thought that the decrease in the expression of the Bad protein, which belongs to a subset of the pro-apoptotic Bcl-2 gene in the nodule structure, may contribute to the pathogenesis of nodule formation. Observing the effects of genetic and environmental factors affecting Bbad expression is thought to be a pioneer in the development of new treatment methods for the goiter disease. Future studies should focus on the expression levels of Bad protein, which is one of the proteins that are effective in the formation of goiter disease [10,11].

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Semi-trailer foodbox design and defining insulation material

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Cite this study: Vurgun, M., Yılmaz, M., & Gedik, T. (2023). Semi-trailer foodbox design and defining insulation material. Advanced Engineering Days, 7, 15-18

Keywords
Highway
Road
Semi-Trailer
Food Box
Refrigerator

Abstract

Road transport is one of the most used transportation methods in the world. Semi-trailer vehicles play a very important role in road transport. These transports can take so long times and the drivers spend their most times in the road. The drivers need to daily requirement. One of the most important of these is to eat during the transport. To satisfy their daily needs to continue their comfort, they need to use a refrigerator. A refrigerator has ability keeping fresh of foods. The drivers use food boxes in semi-trailer but this food boxes without any insulation and refrigerator systems. In this article we found a solution to get fresh foods in these boxes.

Introduction

This text provides background information, description, and analysis of four major cooling technologies—vapor compression cooling, evaporative cooling, absorption cooling, and gas cooling. Vapor compression systems are currently the primary technology used in most standard domestic, commercial, and industrial cooling applications, as they have both performance and economic advantages over the other competing cooling systems. However, there are many other applications in which evaporative cooling, absorption cooling, or gas cooling technologies are a preferred choice.

Cooling technologies are generally divided into air conditioning and refrigeration applications. Air conditioning technologies are defined as those that are used for to maintain acceptable thermal comfort conditions for people and equipment in residential, commercial, and industrial buildings and spaces, typically in the neighborhood of 20–30°C. Refrigeration technologies are defined as those that are used to maintain temperatures near or below freezing (0°C) for safe storage of perishable items such as food and medicine, and operation of low temperature laboratory equipment [1-3].

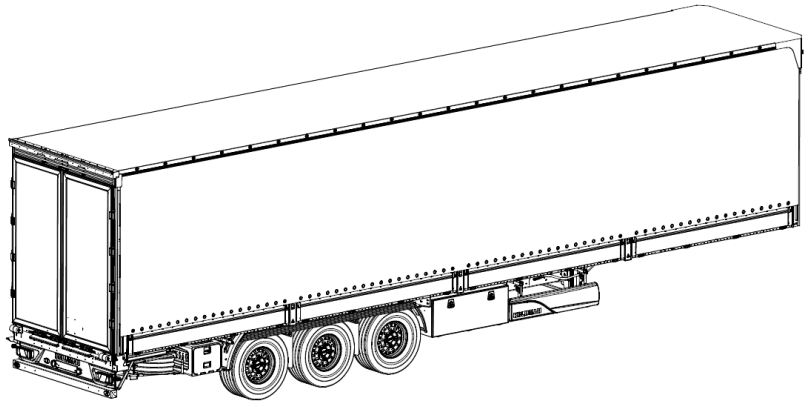


Figure 1. Semi – Trailer

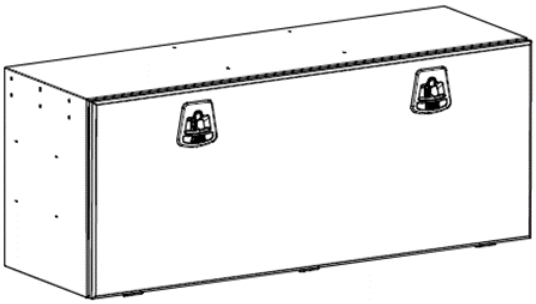


Figure 2. Food Box or Toolbox

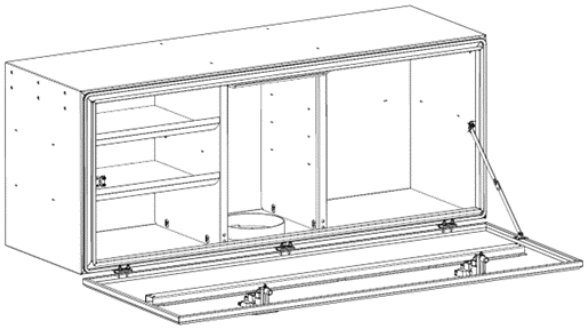


Figure 3. Food Box or Toolbox without insulation and refrigerator

Design Process

In this study, an area of approximately 0.132 m3 was determined in the foodbox of semi-trailer products. The characteristics of this determined volume are as in the Figure 4 and Figure 5.

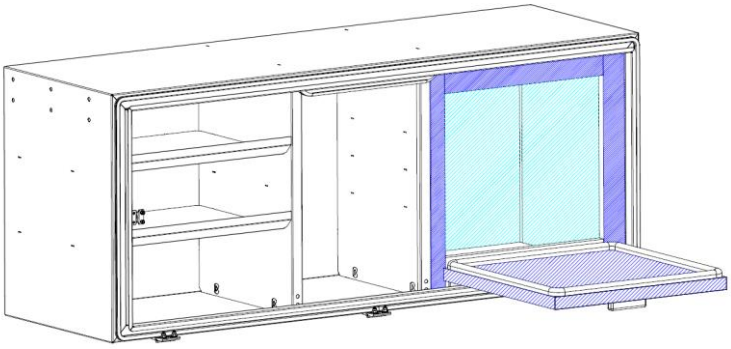


Figure 4. New design food Box or toolbox with insulation and refrigerator

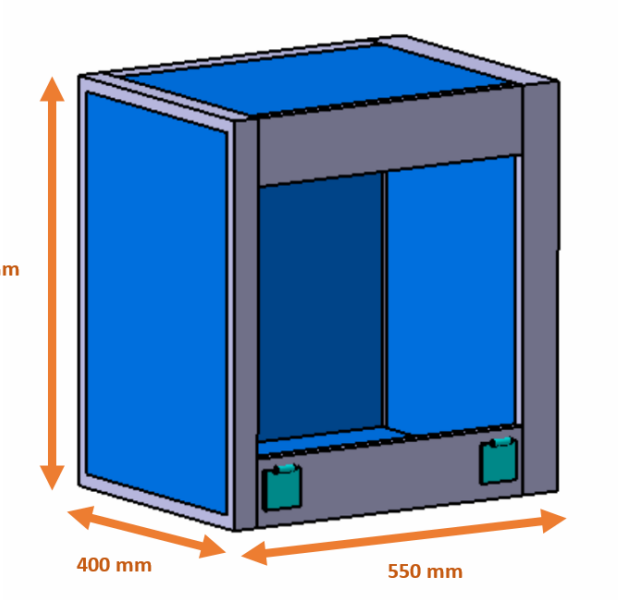


Figure 5. Schematic view of insulation box and dimensions

Total volume of foodbox: 0.5 m^3
Volume of insulation box: 0.132 m^3
Outside Surface Area of insulation box: 1.58 m^2

Defining the thickness of the insulation material

The main aim of the defining of the insulation material is directly related with heat transfer from outer side to inner side.

To keep at lower temperature of the inner volume of the box necessary calculation should be made.

The air conditioning plate was chosen as the insulation material. That material specification as follows.

KOD	: C302-0030
THICKNESS	: 25 MM
THERMAL COND	: @25°C: 0,025 W/M.K

Figure 6. Air Conditioning Plate

Cooling loads calculations

Cooling Load Calculation for cold rooms. In this article we'll be looking at how to calculate the cooling load for a cold room.

Cooling load capacity coming from changing products

In the next step, we calculated the cooling load according to the temperature coming from the new product replacement in the cold room. In this calculation we assumed that cooled the product in the refrigerator is apple.

Q1 = M x Cp x (Tproduct– Tinside)/ 3600
Q1 = 10 x 3,65 x (20–3) / 3600 kwh/day
Q1 = 0,17 kwh/day x 1000 (Convert to Watt)
Q1 = 172 Wh/day
Q1 = 172 Wh/ 24h
Q1 = 7,2 W

Q1: kw / day
M(mass)apple: 10 kg
Cp(specific heat capacity): 3.65 kJ/kg °C
Tproduct: 20 °C
Tinside: 3 °C

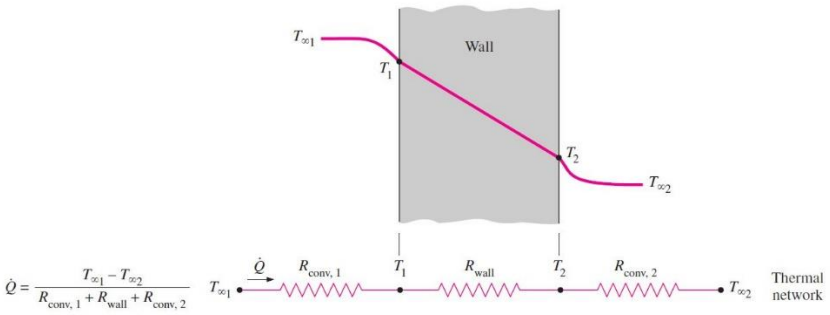
Cooling load capacity coming from absorption

Q2 = M x Resp / 3600
Q2= 10 x 1,9 / 3600
Q2 = 0,0052 kwh / day
Q2 = 5,3 Wh/day
Q2 = 5,3 Wh/ 24h
Q2= 0,22 W

Q2: kw/ day
Mapple: 10 kg
Resp: 1,9 kj/kg

Heat loss from walls

To define how much peltier modules should be used in this design, heat loss energy calculated by below formulas:



$$\dot{Q} = \frac{T_{\infty 1} - T_{\infty 2}}{R_{\text{conv, 1}} + R_{\text{wall}} + R_{\text{conv, 2}}}$$

Q=(40-3)/(0,015+0,63+0,025) Qheat loss=55,2 W

Boundary Conditions
We assume that outside temperature of air T∞1 is 40°C
We assume that inside box temperature of air T∞2 is °C is 3°C
Refrigerator Box Dimensions:

$$Rconv = \frac{1}{h*As} \ (°C/W)$$

Rconv,1=1/(42∗1,58)

Rconv,1=0,015 °C/W

Rconv,2=1/(25∗1,58)

Rconv,2=0,025 °C/W

$$Rwall = \frac{L}{k*A} \ (°C/W)$$

Rwall=0,025/(0,025∗1,58)

Rwall=0,63°C/W

Conclusion

In this design, the insulation material is determined by calculating the heat losses in order to make our refrigerator box suitable for cooling according to the boundary conditions. Initially, the wall thickness was determined as 25 mm. According to this wall thickness, the thermal conductivity coefficient was calculated as 0.025 W/M.K. According to our calculations, the insulation material is technically the product with the code C302-0030.

With the study, insulation material was selected by determining the cooling area we need in the foodbox for semi-trailer products. With these data to be used, the cooling system to be integrated into the determined area has been made applicable.

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Stem-mapping live and dead trees in a mixed fir-pine forest

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Cite this study: Işık, Y. E., & Kara, F. (2023). Stem-mapping live and dead trees in a mixed fir-pine forest. Advanced Engineering Days, 7, 19-21

Keywords
Abies
Deadwood
GIS
Pinus

Abstract

Dead trees are vital to the conservation and sustainability of biodiversity. The number of large-diameter live trees and dead trees in a stand are some of the most common stand characteristics used to determine the structural complexity of the stand. In this study, spatial patterns of trees in a mixed Kazdağı fir (*Abies nordmanniana* subsp. *equi-trojani*)-Scots pine (*Pinus sylvestris* L.) stand was examined, and mapped. Moreover, distribution pattern of the standing deadwoods was also monitored. Distribution of all trees was dispersed, while the deadwoods were clustered within the stand.

Introduction

Biodiversity affects the quality of life on Earth, so maintaining biodiversity is one of the most critical tasks of forest management [1]. Features of stand structure can affect biodiversity. The number of large-diameter live trees and dead trees in a stand are some of the most common stand characteristics used to determine the structural complexity of the stand [2]. Dead trees are vital to the conservation and sustainability of biodiversity [5], and they play a key role in the carbon (C) cycle [3]. Thus, it is very important to determine the distribution of dead trees in the stands and to determine the factors affecting this distribution.

Detection of the spatial distribution of trees in stands has been useful in estimating stand dynamics, analyzing canopy spacing, conserving biodiversity, examining regeneration, and making inferences about ecological mechanisms [4]). The "horizontal pattern" of trees is widely used to determine the stand structure, and they are usually determined by "point pattern analyzes" [5]. Tree species can show a random distribution, cluster in the stand or show a regular distribution within the stand. Spatial distribution of trees can be shaped by competition conditions among forest trees, tree death due to density in the stand, and disturbance of the canopy.

Various studies have been conducted on the spatial distribution of trees in the stands in forests consisting of different tree species [6]. However, studies on the spatial distribution of dead trees in the stand are very limited. Kazdağı fir (*Abies nordmanniana* subsp. *equi-trojani*) and Scots pine (*Pinus sylvestris* L.) are two of the most economically and ecologically important tree species in Turkey. These forests also exhibit a rich biodiversity in their distribution in northern Turkey. Although there have been various studies on the number of dead trees in Kazdağı fir forests, there is no study on the spatial distribution of the dead trees in forests dominated by Kazdağı fir. Therefore, the main purpose of this study was to determine the spatial distribution of dead trees in a mixed Kazdağı fir-Scots pine stand. It was also aimed to map all tree species using standard procedures for stem mapping of trees within the study area.

Material and Method

This study was carried out within the borders of Ilgaz Mountain National Park in Kastamonu province. The study area is in the transition zone between the Black Sea climate and the continental climate of Turkey. The average temperature of the region is 5.2 °C and the annual average precipitation is 612 mm. The dominant soil group is brown calcareous. The altitude in the study area varies between 1000 and 1900 m. In addition to Kazdağı fir and Scotch pine, other tree species that can be seen in the Kastamonu region are black pine (*Pinus nigra* Arnold.), eastern beech (*Fagus orientalis* L.) and oak (*Quercus* spp.).

In order to determine the distribution of dead trees, the Ilgaz Mountain National Park was chosen as the study area for this study, since protection forests with natural stand dynamics were preferred. First of all, a working plot of approximately 3-4 hectares was selected in the study area. In order to determine whether the distribution of dead trees differs according to tree species, attention was paid to the fact that the study plot is a mixed field consisting of Kazdağı fir and Scots pine. Stem mapping of all trees in the study area was made with the help of ArcMap program using standard procedures.

First of all, a reference point was determined within the work plot and its coordinates were recorded with the help of handheld GPS. Then, the distances between the reference point of all trees that can be seen from the reference point was measured with a TruPulse 360 laser device. In addition, the degrees of deviation of trees from the reference point (i.e., deviation from north; azimuth) was also recorded using a compass. After all trees visible from the first reference point were recorded, a second reference point was established and the same procedure was followed until all trees in the selected study plot were registered. To determine the individual coordinates of each tree, the coordinates of the reference points and the distances and azimuth values of the trees from the respective reference points were be used. For each tree with a diameter (d1.3) at chest height greater than 5 cm in the study plot, the diameter d1.3 (cm) were measured with the help of a caliper and the types of trees were recorded. Whether the tree measured in the study plot was alive or dead was also recorded.

After determining the individual coordinates of all trees in the study plot, these data were added to the ArcMap program and stem maps of the trees were created. The "Average Nearest Neighbor Analysis" in ArcMap was used to calculate the average nearest neighbor distance of both all trees and dead trees in the study plot. Also, Ripley's k-function analysis was used in ArcMap to see if the point distribution was clustered, random, or scattered. Visual evaluation of the spatial distribution model of all trees and dead trees was also performed and interpreted using both the R-statistics software and ArcMap. Stem map was used to determine the factors affecting the distribution of dead trees (such as thick live trees, presence of other species, stand density).

Results and Discussion

The observed mean distance, which means how far each tree is from the next on average, was 1.97 m. The expected mean distance based on a random distribution throughout the sampling area was 0.33 m between each tree. Based on the Average Nearest Neighbor Analysis, the distribution of all trees across the study stand was dispersed, while the deadwoods were clustered (Table 1). Map of point patterns attained following stem mapping indicated that there were clustering of trees within the study plot (Figure 1). Moreover, canopy openings were also apparent in stem-map.

Table 1. Average Nearest Neighbor Analysis Summary

	All Trees	Dead Trees
Parameters	Values	
Observed Mean Distance (m)	1.917	4.785
Expected Mean Distance(m)	0.033	6.310
Nearest Neighbor Ratio	56.52	0.758
z-score	2712.4	-4.185
p-value	0.0000	0.0001

Figure 1 shows the spatial distribution of trees by species, and diameter size. The stand is mostly dominated by firs. Firs were mostly present in all diameter classes; this can be attributed to its shade tolerance since firs can survive and grow under high stand densities for prolonged times. Pines were mostly present in relatively larges diameters (Figure 1). This is mostly because Scots pine is a shade-intolerant species and it did not have enough chance to recruit under shady conditions. Deadwoods were available in most diameter classes ranging from 5 to 83 cm. About 95% of the dead trees was fir (Figure 1).

The presence of mostly small forest gaps is revealed by the close spacing between trees. When it was looked at the spatial patterns of Norway spruce (*Picea abies* L.) [7], they found that smaller canopy gaps can be caused by reduced mean distances between trees. Canopy gaps can further create clustered spatial patterns of trees [8]. The presence of relatively larger trees that are close to and around the canopy gaps raises the possibility that these gaps were caused by the demise of specific, massive trees. These sort of canopy gaps are typically caused by wind-throws, insect damage, diseases, lightning, etc. since these tree species typically grows in an area where these disturbances occur frequently [9]. Trees may develop in the gap left over when one or more old trees are destroyed by storms, insects, illnesses, or lightning. Little canopy gaps may also result from competition for underground resources between large trees.

Fir is known to be a shade tolerant species; thus, fir seedlings are usually present under canopy waiting for overstory disturbances to star height growth. A new opened space is usually colonized by juveniles because competition for light and other nutrients with overstory trees is usually decreased when a canopy opening is formed [10].

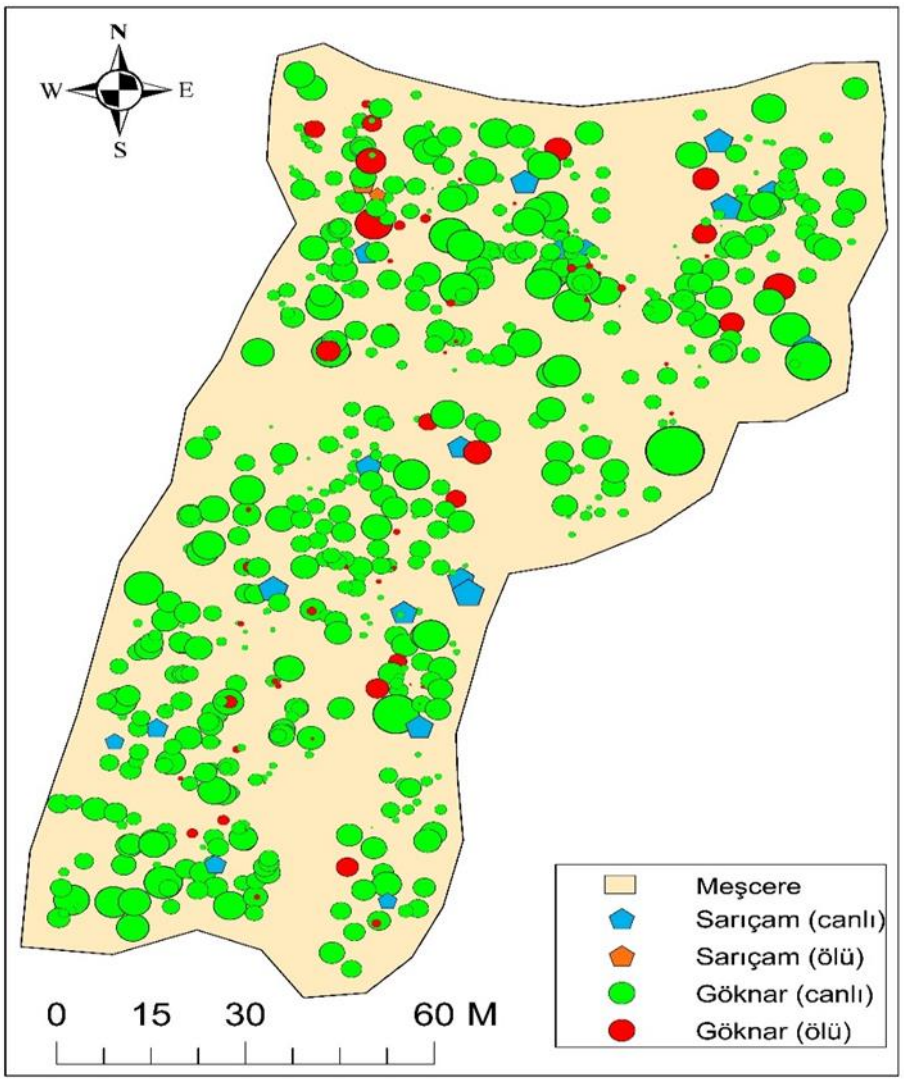

Figure 1. Stem-map in a mixed fir-pine stand

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Comparison of different algorithms with a single GNSS receiver

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Cite this study: Altıntaş, A. F., Usta, S., Karadeniz, B., & Pehlivan, H. (2023). Comparison of different algorithms with a single GNSS receiver. Advanced Engineering Days, 7, 22-26

Keywords
GNSS
Network-RTK
PPP
CORS-TR

Abstract

In Nowadays, many terrestrial or satellite-based positioning techniques have developed systems and methods to obtain the needed location information at low cost, real-time and precisely Nevertheless, each technique has undergone significant refinement and evolution, effectively converting the drawbacks of prior methods into notable advantages. In this study, the position accuracy of Network-RTK (Network-Real Time Kinematic) and PPP (Precise Point Positioning) techniques, which are trending in positioning techniques with GNSS, are examined and their advantages and disadvantages are revealed. Root mean square errors (RMSE) were calculated to test the point location accuracy. The findings of the study indicate that the N-RTK technique exhibited superior performance over the PPP technique in all three components: North, East, and Up. However, it is worth noting that the PPP technique showed significant improvement in RMSE values after convergence, as the convergence of integer phase ambiguity took place. Additionally, by increasing the utilization of satellite observations and obtaining more accurate satellite orbit and clock correction information, the accuracy of PPP-based results approached that of the N-RTK technique. These results suggest that with enhanced data combinations and refined correction information, the PPP technique has the potential to achieve comparable position accuracy to that of the N-RTK technique. Nonetheless, it is important to acknowledge the initial superiority of the N-RTK technique in the specific aspects studied.

Introduction

In Nowadays, numerous institutions and companies, particularly those involved in geomatics engineering, have been effectively employing the Network-RTK (CORS) technique, also known as Continuously Operating Reference Stations (CORS). This technique enables the precise determination of point locations using a single GNSS receiver, without the requirement of any fixed ground point. Furthermore, these locations can be determined instantly, showcasing the high accuracy provided by the CORS technique [1-3].

However, the Network-RTK technique has a limitation in that it relies on the availability of GNSS infrastructure and bidirectional data communication (such as GSM or GPRS) between the reference stations and the mobile receiver. In situations where such communication is not possible, the point location cannot be determined using the Network-RTK technique.

On the other hand, the Precise Point Positioning (PPP) technique offers a strong alternative to Network-RTK. It allows for the calculation of point positions with high accuracy using a single GNSS receiver, without requiring raw measurements or correction information from a known reference point, and without dependence on any specific GNSS infrastructure. This makes PPP a valuable method in scenarios where the Network-RTK technique is not feasible or practical [4,5].

During the determination of point location using the PPP technique, certain external parameters are required, including solid earth tide, ocean loading, and accurate satellite orbit and time information. Moreover, the PPP method operates on the fundamental principle of treating the phase initial ambiguity as unknown. This characteristic often results in an extended measurement time for achieving centimeter-level sensitivity in PPP solutions, compared to relative positioning methods. To address the issue of convergence time stemming from the resolution of integer phase ambiguity in the PPP technique, several methods and models have been developed. These techniques aim to optimize the time required to obtain reliable solutions [6-10].

In this study, the position accuracy and comparative advantages of the CORS-TR (CORS-Turkey) and RT-PPP (Real-Time-PPP) techniques, which utilize a single GNSS receiver, have been investigated.

Material and Method

In this section, GNSS receiver and observation data sets used in static experiment design with different algorithms are introduced. In addition, the quality of GNSS observation data and the algorithms used for position determination are explained. Within the scope of this study, GNSS observations were made at the N.211 and G.22012 triangulation points, whose coordinates are known, in static mode, simultaneously at 1 Hz sampling interval.

In N.211, where GNSS observations are made, instant location information is provided by receiving corrections from the CORS-TR system. However, due to internet quality, location information could not be produced in some epochs. On the other hand, a static session was held at the G.22012 point and the observation data were recorded for post-process. The experimental design, which was made in a static session, lasted approximately 2.5 hours on the campus of Gebze Technical University on May 9, 2023. In addition, in the RT-PPP technique used in this study, satellite orbit and clock correction information produced by CNES (National Space Research Center) in real-time conditions was used. All process steps of N-RTK during the experiment and RT-PPP techniques after the experiment are shown in Figure 1 and Figure 2 in detail, respectively. During the experiment, GNSS raw observation data was recorded via the CHC I80 GNSS receiver/antenna. With the satellite orbit and clock correction information obtained over the internet from the CNES archive of the experiment day, solutions were made with the static-PPP technique in real time in the rtkpos application of the RTKLIB software. On the other hand, the point position was obtained by N-RTK technique, with the help of the corrections obtained by the GNSS receiver via the internet and the satellite observations made by connecting to the CORS-TR system during the experiment.

Results and Discussion

In this section, point positions are compared in the time domain by making simultaneous 2.5-hour observations at the N.211 and G.22012 triangulation points with known velocities at epoch 2005.0 in the ITRF 20 ((International Terrestrial Reference Frame-2020)) datum, by applying Network-RTK and RT-PPP techniques, respectively. In the experiments, with the Network-RTK technique applied at the N.211, position components were obtained at the sampling interval of 1 second during the experiment. However, the obtained position components are at epoch 2005.00 in the TUREF (Turkish National Reference Frame) system, that is, the ITRF-96 datum. In addition, the raw GNSS observation data used to determine the point location belong to the GPS and GLONASS system. In this case, velocities were calculated in the ITRF-2020 datum and the measurement epoch to compare the point location components with the referenced coordinates. During the experiment, as a result of receiving the corrections from the CORS-TR network via the internet, it caused data loss in some epochs depending on the internet speed.

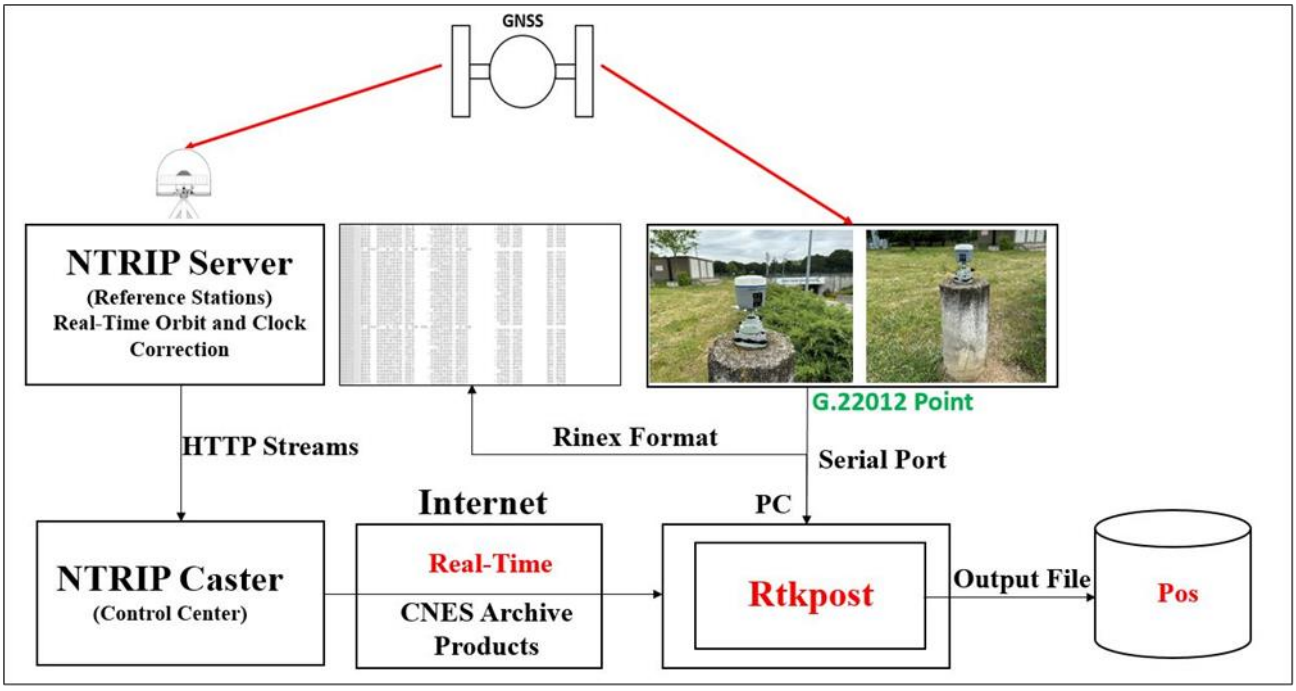

Figure 1. Schematic view of the static-RT-PPP method with a GNSS receiver/antenna

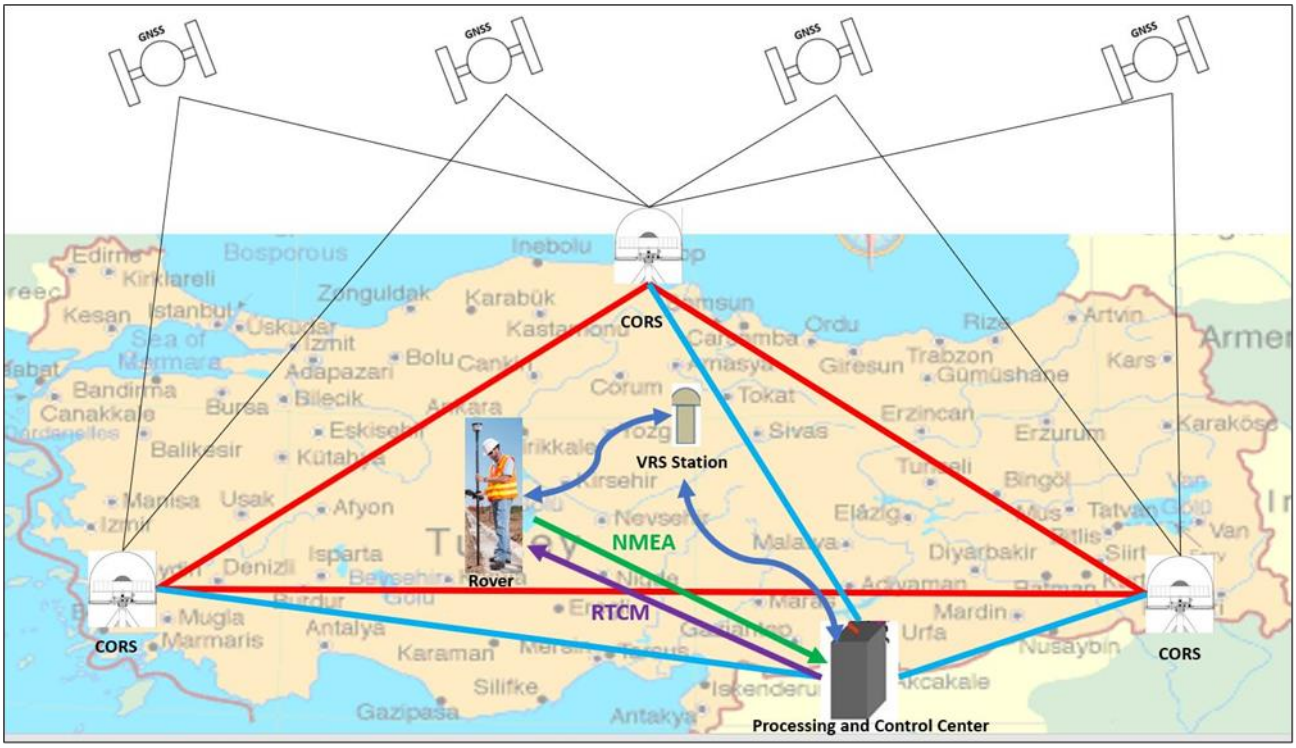

Figure 2. VRS method in Network-RTK technique

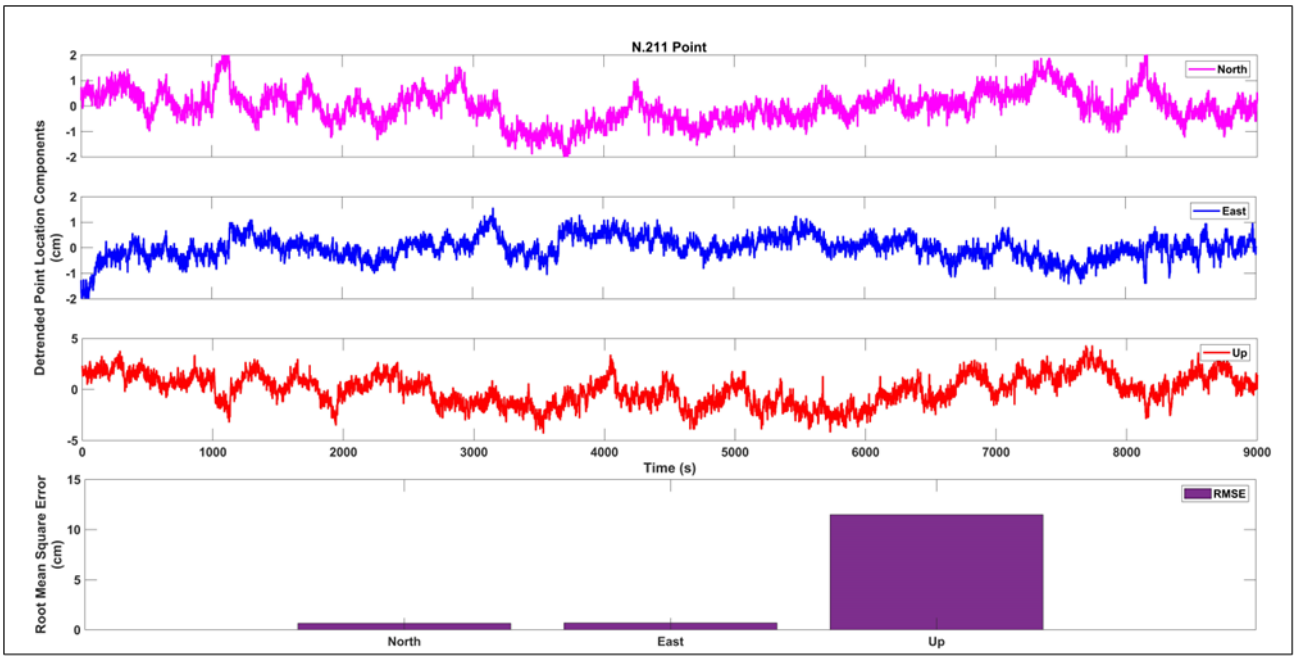

Figure 3. Time series and RMSE of point location components of Network-RTK solution of N.211

This data loss is compensated for by using nearest neighbor interpolation. The North, East and Up components of the N.211 point in the time domain of the Network-RTK solution, respectively, are shown in Figure 3. Detrend was applied to extract the offsets and linear trends seen in the position components obtained throughout the experiment. The time series in lines 1 and 2 in Figure 2 show the North and East components, respectively. Static measurements show a displacement between -2 and +2 cm for both horizontal components. Looking at the up component, this value varies between -5 cm and +5 cm, and the position accuracy in itself is lower than the horizontal component. In the last part of the figure, it is ±7 mm in the horizontal component and ±10 cm in the vertical component, according to the referenced coordinates. On the other hand, the time series of the point position components obtained by the PPP technique using the satellite orbit and clock correction information produced under real-time conditions in static mode of the raw satellite observations obtained from the GNSS receiver installed at the G.22012 Triangulation point is given in Figure 4. The evaluation after the time taken for the convergence of the integer phase ambiguity in the PPP technique is also shown on the same figure. In the right

part of Figure 4, the displacements in the time domain after convergence range from -2 to 2 cm for the horizontal component and -4 to 4 cm for the vertical component. While the mean square error value in the northern component was 35 mm throughout the experiment, it was calculated as 5.5 mm after convergence. While it was 80 mm during the whole experiment for the eastern component, it decreased to 71 mm after convergence.

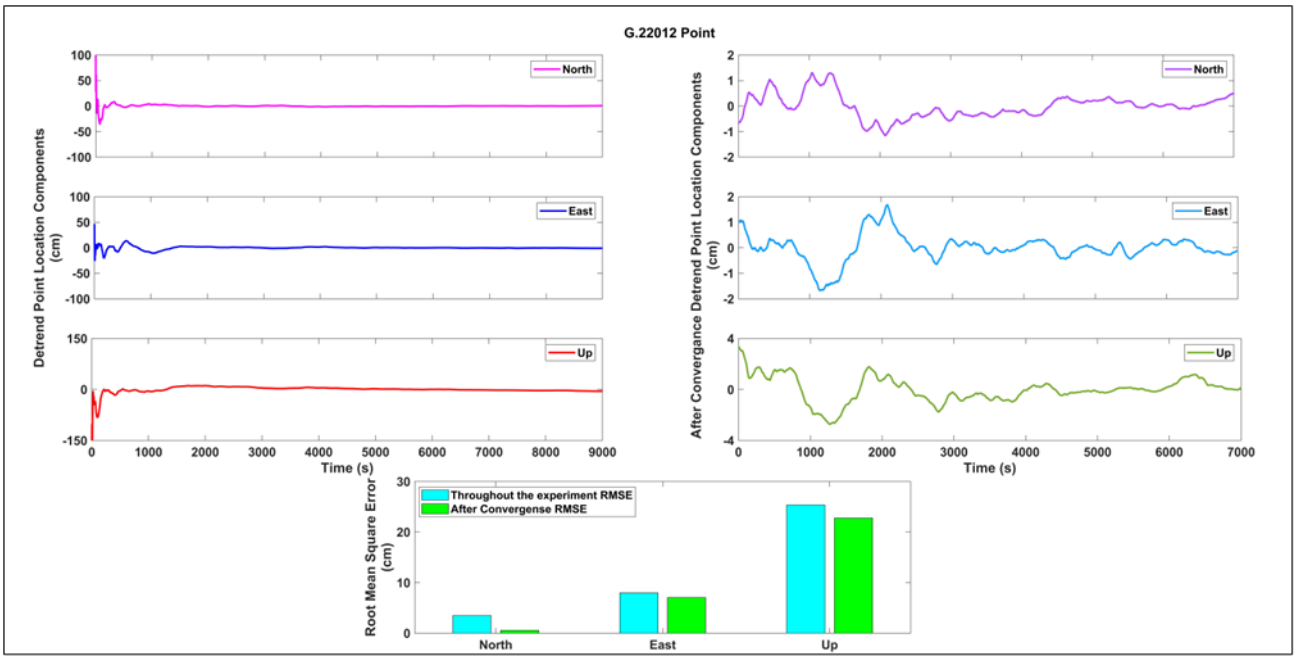

Figure 4. Time series and RMSE of point location components of RT-PPP solution of G.22012.

While the vertical component was 25.4 cm during the whole experiment, it was found to be 22.8 cm after convergence. In real-time static-PPP solutions, after convergence, there is a decrease of approximately 1 to 3 cm in the mean squared error values in the horizontal component, while a decrease of about 1 cm in the vertical. However, considering the coordinates referenced at two points, it was found that the RMSE values of the solutions made with the Network-RTK technique had the lowest values both horizontally and vertically compared to the other points.

Conclusion

In this study, the performances of the methods were tested by making simultaneous observations at 2 triangulation points with known coordinates to compare different algorithms with a single GNSS receiver under the same conditions. During the experiment, point locations whose coordinates and velocities were calculated by the static method were taken as reference in order to compare the Network-RTK and RT-Static-PPP methods with each other. When the solutions obtained during the whole experiment were compared, the best result was obtained from the Network-RTK solution. It was also observed that there was a significant improvement in RT-PPP solutions after convergence. In addition, the high cost of the infrastructure and necessary equipment of the CORS-TR system, and the inability to receive corrections by mobile receivers in limited regions where internet/GSM data transmission means are weak are the major disadvantages of the method. However, these needs are not required in solutions based on PPP technique. Due to the nature of the PPP technique, a certain period of time must be waited for the integer phase uncertainty to converge. Although the PPP-AR technique was developed for this problem, it could not be applied within the scope of this study. Because the signals received from the satellites of the GNSS receiver/antenna used and the analysis centers affiliated to IGS are not included in the bias file produced for the corrections brought to the satellite signals. Looking at the Network-RTK results throughout the experiment, there are epoch losses due to internet speed. Although this problem is solved by the interpolation method in the analysis part, the quality of internet/GMS tools, which are data transmission tools, should be increased at every point in the network for the corrections coming from the Tusaga-Aktif system. However, in the CORS-based Tusaga-Active system, the inclusion of the necessary correction information for the solution of GPS, GLONASS satellites as well as Galileo and BeiDou satellites will affect the result more accurately.

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Appropriate vibration wedge selection and calculations

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Cite this study: Şahin, M. E., & Kurgun, M. A. (2023). Appropriate vibration wedge selection and calculations. Advanced Engineering Days, 7, 27-29

Keywords
Vibration
Damping Vibration
Wedge

Abstract

The industrial revolution, which began with the invention of the steam engine, keeps developing with the Internet of Things. The use of machinery continues to increase at every stage of this development. The majority of the machines used do work with the help of rotational movement. The interaction between the systems to which the machines are connected and the machine during the rotational force causes some problems. The biggest trigger of these problems is the uncontrollable vibrations. Due to these uncontrolled vibrations, many serious problems such as wear, cracking, and even breakage occur in the machines or the systems to which they are connected. Although it is very difficult to prevent these vibrations during the application, it is possible to keep the vibration under control. Vibration wedges are the most preferred equipment in this regard. In this article, the calculations of the vibration wedge required to control vibration and the points that should be considered in the selection of the wedge will be explained.

Introduction

Vibration is the mechanical oscillation that occurs around a point of equilibrium. This oscillating motion can be periodic, like a pendulum, or irregular and random, like the movement of a wheel on a rough and rocky road [1]. An elastic system under the influence of externally applied forces is called forcing, and oscillating movements resulting from the externally applied force are called forced vibration. If there is any energy loss or damping event, this movement is damped vibration. The remainder after the instantaneous events have disappeared is called the steady-state vibration. Discontinuous vibrations create serious problems when impacted by live loads, shocks, and impacts. Said damage is shown in Figure 1 [2]. These movements may not always be periodic, and mechanical failure from discontinuous vibration is often associated with exceeding the mechanical strength of some components. To eliminate these problems, vibration damping wedges are used.

Figure 1. Vibration Damage [2]

Material and Method

Rubber, which is a natural substance, is obtained from the rubber tree. Thanks to its high elasticity, rubber has many uses. The oil obtained from the melt is used as a solvent in further processing. Almost all of the tires obtained from rubber, which is popularly known as pure rubber, are pure [3].

Vibration wedges are rubber elements that dampen the vibrations and impacts that occur in the mechanisms they are connected to and prevent their transmission and at the same time reduce the noise. The vibration wedge absorbs axial and radial forces. Vibration wedges protect the mechanism and its elements and ensure their longevity with these duties. An example of a vibration wedge is shown in Figure 2 [4].

Figure 2. Vibration Wedge [4]

Vibration wedges are rubber elements that dampen the vibrations and impacts that occur in the mechanisms they are connected to and prevent their transmission and at the same time reduce the noise. Vibration wedges absorb unwanted vibration forces. Vibration wedges protect the mechanism and its elements and ensure their longevity with these duties. In this way, they protect the mechanism in which they are used, ensuring their longevity.

A number of calculations are required to determine which vibration mount to use in a vibratory system. First of all, the operating speed of the system should be determined. After determining the operating speed, the "Transmission Ratio" of the vibration to the system body is accepted as the limit 10% [5] and *wn* (natural frequency of the system) is calculated in accordance with the Equation 1. Care is taken to ensure that the w/wn value is not a multiple of $\sqrt{2}$ in order to prevent the system from resonating [6]. After the *wn* value is determined, the Equation 2 is applied [6].

$$\text{Transmission Ratio} \rightarrow \quad \beta = \left| \frac{1}{1 - \left(\frac{\omega}{\omega_n}\right)^2} \right| \tag{1}$$

$$\omega_n = \left(\frac{k}{m}\right)^{1/2} \tag{2}$$

While the m in this formula represents the total mass of the system, the value of k represents the spring strength which is considered sufficient for the system. After determining the spring strength, calculation is made according to the number of vibration wedges to be used in the system (For example, k/3 value should be used for 3 vibration wedges). While this value of k indicates whether the vibration wedge can dampen or not, it is important that these vibration wedges can carry the system. In this context, the weight of the load to be mounted on the vibration wedge should be calculated (Mass x Gravitational Acceleration) and the amount of load that this vibration wedge can carry should be checked.

Conclusion

We can decide which chock should be used in a system that has problems due to vibration as follows. At first, we have to determine the operating speed of the system and then we should find the natural frequency of the system by accepting the transmission rate of this system as 10%. In order to check the accuracy of the result found, we should check that the working speed/natural frequency ratio is not $\sqrt{2}$. We can determine the spring strength that is suitable for the found natural frequency. We list the vibration wedges with detected spring strength, examine their carrying capacities and decide on the vibration wedge required for the system.

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Creation of a point cloud of a historical structure using the terrestrial laser scanning method – The Example of Bezmialem Valide Sultan Fountain

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Cite this study: Sarıtaş, B., Aydar, U., & Karademir, B. (2023). Creation of a point cloud of a historical structure using the terrestrial laser scanning method – The Example of Bezmialem Valide Sultan Fountain. Advanced Engineering Days, 7, 30-32

Keywords
3D model
CloudCompare
Lidar
TLS

Abstract

In order to ensure that the structures are repaired again as a result of possible natural disasters and day-to-day wear and tear of historical structures, it is necessary to create 3-dimensional models. One of the methods used in the realization of this model is terrestrial laser scanning. As a result of scanning the historical structures in question in different sessions with the terrestrial laser scanning method, a point cloud is obtained and used in relay studies. The filtering process is performed first for the use of point clouds. The filtering process was carried out by removing the point data found in the environment during the scanning of the structure to be studied and which were considered noise in our study. In our study, CloudCompare software was used in order to turn the point clouds obtained as a result of different sessions and the filtering process completed into a single structure. In order to combine the point clouds, control points established before the scanning process started and natural points located on the structure were used.

Introduction

In order to be used for repairing damages that may occur as a result of damage to historical structures, terrestrial laser scanning (TLS) technology can be used to create substrates for creating sections of 3-dimensional (3D) models.

Traditional geodetic measurement methods, whole ground measurement or real-time (RTK) GPS measurements are not very suitable for quickly accessing geometric and visual information of the object. These allow only individual point measurement. For this reason, these methods are usually slow. Modern reflector-free total stations and other developing technologies also have point-based scanning functions. However, the excessive scanning time, the low number of points obtained, the inability to obtain sets of points suitable for the actual model of the scanned object have brought the terrestrial laser scanning technology to the forefront [1].

Laser scanners provide imaging in the form of a point cloud by scanning the object to be measured in the form of arrays of dots under a certain angle in the horizontal and vertical directions. For each laser point, the scanner instrument-centered polar coordinates are measured. These are; the inclined distance to the measured point, the angle that the measuring line makes in the horizontal plane with the x-axis, and the angle of inclination that the measuring line makes with the horizontal plane [2].

If the external surfaces of a building are to be scanned for architectural relay, the tool is installed at any point and the area seen on the building surface is scanned. Then, the scanning is performed by installing the instrument in a suitable place so that it scans the adjacent area of the first scan. Each scan is performed in such a way as to create common scanned areas at a certain rate with the previous scan. These common scanned areas are necessary for the joining of point sets. [3].

The aim of my study is to create 3D models as base data for use in repair operations in case of destruction and damage caused by possible natural disasters and day-to-day wear of historical structures.

Study Area

Bezmialem Valide Sultan Fountain was built by Bezmialem Valide Sultan on Besiktas Sports Street on the Rumeli side of the Bosphorus in Istanbul in 1839. It is a square fountain with four facades. The fountain was built with the empirical style [4].

Material and Method

TLS was used to create a 3D point cloud of Bezmialem Valide Sultan Fountain. First of all, control points have been established on the structure in order to be able to use it during the merging of scanning data. The scans were performed in the local coordinate system and eight different scanning operations were performed. During the scanning operations, it was taken into account that there were overlays between consecutive scans, that is, there were common control points Decoupled in the scanning data.

During the scanning of the structure, objects in the environment are included in the scanning data. Points other than the structure should be cleaned both because of the high size of the data and because it causes difficulties to the operator during the processing of the data. The filtering operations were carried out manually with the help of CloudCompare, a free software. After only the data belonging to the structure remains in each session, the registration process is performed using CloudCompare software again so that a 3D model of the object can be created. During sequential scanning, the control points common to both scans are matched.

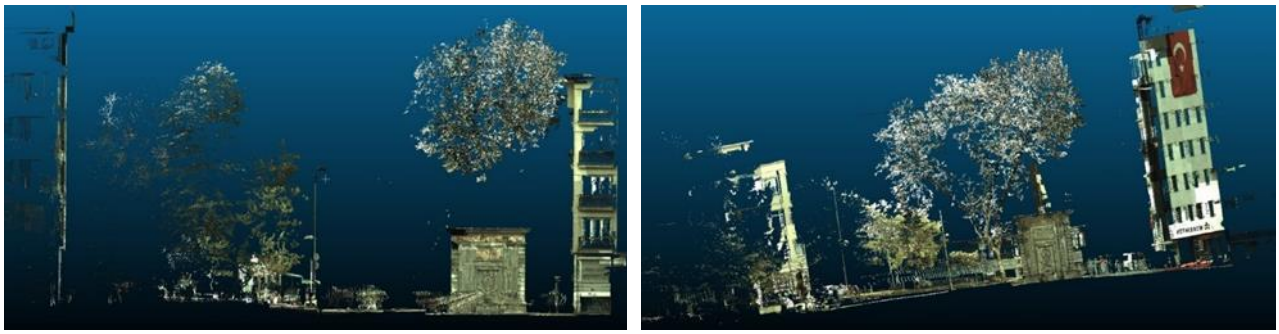
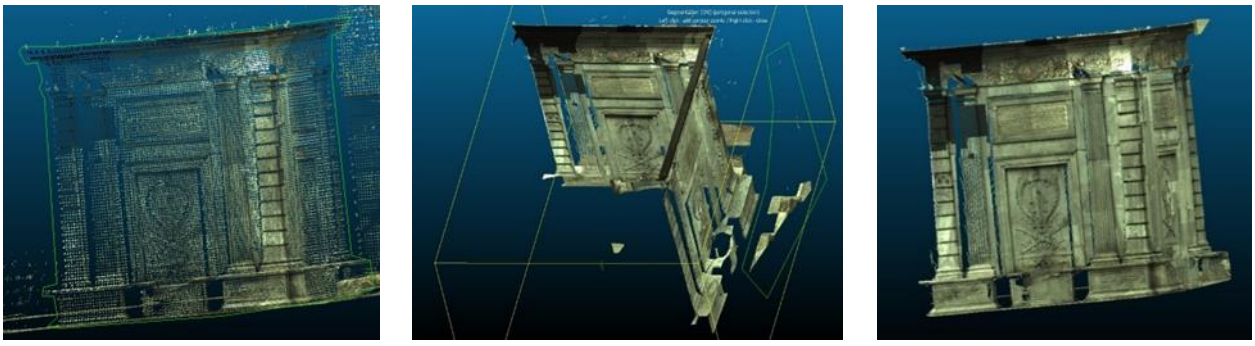


Figure 1. An example of the scanning data obtained with different sessions

Filtering the noise from point cloud

The point cloud data for each scan goes through the filtering process separately. After the data is transferred to the CloudCompare environment, the segment button is selected and the points belonging to the structure that want to be filtering of noise points are surrounded in such a way as to form a closed polyline. By deleting the points remaining outside the selected parts, it is ensured that the noise points remaining around the structure are filtered. In the same way, it is possible to delete the selected parts by selecting noise points. The point cloud is examined from different angles and the filtering process continues until the noise points are detected and only the points belonging to the structure are left. This process is repeated for scanning data for all fronts.



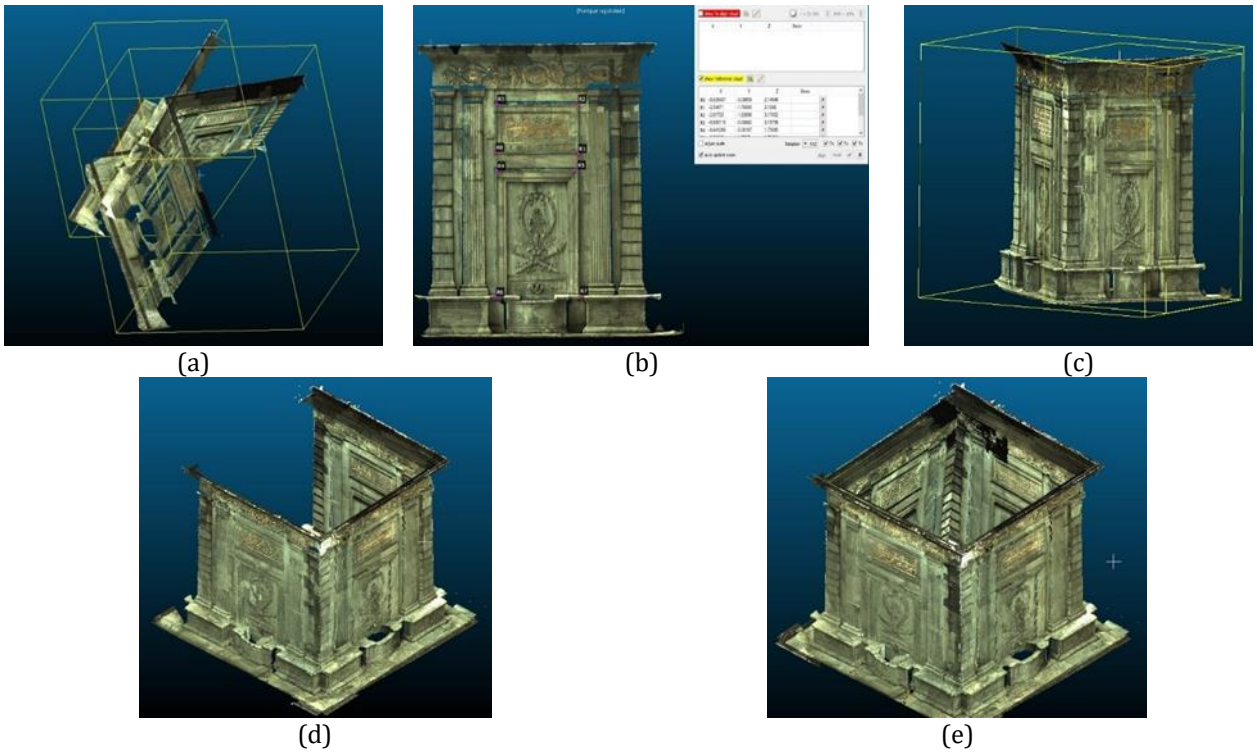
(a) (b) (c)

Figure 2. (a) selection of points belonging to the structure, (b) detection of noise points, (c) point cloud formed by filtering noise points

Merging the point cloud

The registration process is performed in order to Decouple the data obtained in all scans and to ensure that all the details of the structure are contained in a single point cloud. In order for the 3D model to be created precisely,

the common surfaces are combined with the matching of control points. Since each successive front screening is carried out by having common control points with each other, matching common control points allows a more accurate model to be created.



(a) (b) (c)

(d) (e)

Figure 3. (a) displaying the scan data to be matched in local coordinates, (b) selection of control points located on the structure, (c) two fronts mapped using the control points, (d) three fronts mapped using the control points, (e) mapping all the facades of the structure and creating a 3D model

Conclusion

With the 3D point cloud created, Bezmialem Valide Sultan Fountain will be able to be used as base data in the restoration work that will be carried out to restore it to its former state if it is damaged in any case. When we look at the advantageous side of the process performed, it is ensured that data can be obtained faster and with more precise accuracy compared to classical methods. The roof of the structure was not included in the model because it was not scanned. In order for the roof part to be included in the model, the scanning process can be performed with the help of a drone, and the obtained scanning data can be integrated into the model in the point cloud belonging to the roof. It can be determined how sensitive a model has been created by performing an accuracy analysis of the operations performed. The accuracy of the created model can be determined in future studies.

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Investigation of mining-access roads within the general concept of forest roads

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Cite this study: Genç, Ç. Ö., & Altunel, A. O. (2023). Investigation of mining-access roads within the general concept of forest roads. Advanced Engineering Days, 7, 33-35

Keywords
Forest land
Mining endeavors
Access roads
Type-B Forest Road

Abstract

Forest resources serve the communities in various aspects, such as raw timber production, recreation, aesthetic, hydrological assurance, health of societies, wildlife management and sustainable management of biodiversity. One third of our country is covered with forest, and the majority of the mining endeavors also exist underneath these forests. Issues regarding the governance of forest resources are regulated under the constitutional act #6831, while the article 16 explains how mining endeavors are allowed within the forest lands. Unless accessible via forest or village roads, access to the mining side and accompanying installations can only be granted with additional linkage and new road layout projects. Since they will also be used as forest roads in the long run, forest service asks from the mining license holders to construct them according to the standards dictated in the notification 292. Although crucial for any type of operation, roads might jeopardize the ecosystem services and cause irreversible harm to the habitats, so utmost importance must be shown while placing them over pristine topographies. In the context of this study, one of the foremost detrimental environmental effects of mining endeavors, access roads were evaluated in terms of the compliance with the notification 292 standards, which stated that any additional non-forestry related road should be constructed according at least to Type-B style forest road standard.

Introduction

In order to manage the forests, forest road networks are laid and maintained to reach the resources, to transport production means to the sites and to efficiently extract the produced timber out of the forest land while preserving the integrity of the soil, remaining stands and landscape aesthetics [1].

As long as the extent of forest road networks is effective and sufficient, any type of scientific, technique and managerial intervention can reach to every part of the land without altering the natural increment cycle of the stands while everything produced in the name of both forest and non-forest products can be taken out of the forest land [2].

According to the act 6831 which was constitutionalized in 1956, Turkish forests are categorized under three categories; production forests, conservation forests and national parks [3]. While constructing the forest roads, the needs of the production forestry are prioritized. However, applying this approach single-handedly leaves the sensitivities of the other categories unanswered [4].

It is the primary objective of forest road planning that they fully serve towards achieving multi-purpose functional use from the forests, provide access to the well-being and development of forest villages, cause minimal land-cover change and degradation, and provide safe and continuous travel year-round.

As in any type of engineering undertaking, forest road planning and construction need to be travel-safe and economic in accordance with environmental concerns. To address these concerns, they must comply with basic standards specified for them [5].

Majority of the forest roads being constructed in Türkiye, suit Type-B Road standards required for timber production needs. The code states that they need be at most 5 m wide, including the side ditch, and the annual tonnage that would be transported over these roads, should not exceed 25000 m^3 [6].

Coincidentally enough, a considerable portion of our natural ore deposits exists underneath the forested lands. Concessions are always granted for mining activities however there is no specified regulation dictating how the site access would be provided. Instead of haphazard site access attempts, the road constructions undertaken by the mining license holders, need to be in accordance with the foresters' practices so when the mining activity is finalized, the access road(s) could easily be integrated into the existing forest road network.

Environmental effects of mining activities

Mining is one of the building blocks of a developed society, and Türkiye is quite fortunate with such wealth [7]. When mining contribution to GDP is investigated for the last 20 years, it is obvious that it has averaged around 1%, and it is expected to increase more as the 21th century progresses [8]. Mining feeds the other crucial sectors, such as industry, energy and agriculture, all of which are key factors in becoming a developed country and providing high standards for the well-beings of its people. As societies grow, the need for rawer material also increases, consequently the mining activities also speed up. However, little or extensive, mining activities in general leaves noticeable scars over the topographies and disrupts the ecologic balance [9]. Especially in open-pit mining, there are multitude of examples across the Earth that the left-over site is ravaged in terms of topography, geology, hill-shade characteristics, water regime, micro-climate and landscape aesthetics, and vegetation cover is stripped (10). Thus, it should never be overlooked that the gain which would be obtained from mining activities for societies' well-being, should never outweigh the environmental concerns that they will surely cause [10].

Concessions, relying on the article-16 under the general forest act of #6831, have long been granted for mining activities and their compulsory installations within the forest lands, therefore especially roads are immediately needed for reaching out the site(s). However, there is no standard which would otherwise be required, for mining related access road installations within the forest roads [11]. Although in 2005, the ministry of environment and forestry dictated all regional directories of forestry that the mining related access road demands coming from the license holders must comply with the forest road construction standards, the practices experienced all around the country fall seriously behind what are expected from them. Consequently, environmental adversities, which are associated with such mining activities, continue expanding beyond the specified concession area(s).

In the scope of this study, visual investigation of a random mining access road was performed over Google-Earth to see if they comply with the required standards so the would-be resulting consequences were kept at bay. Type-b reference forest road standard was observed (Figure 1).

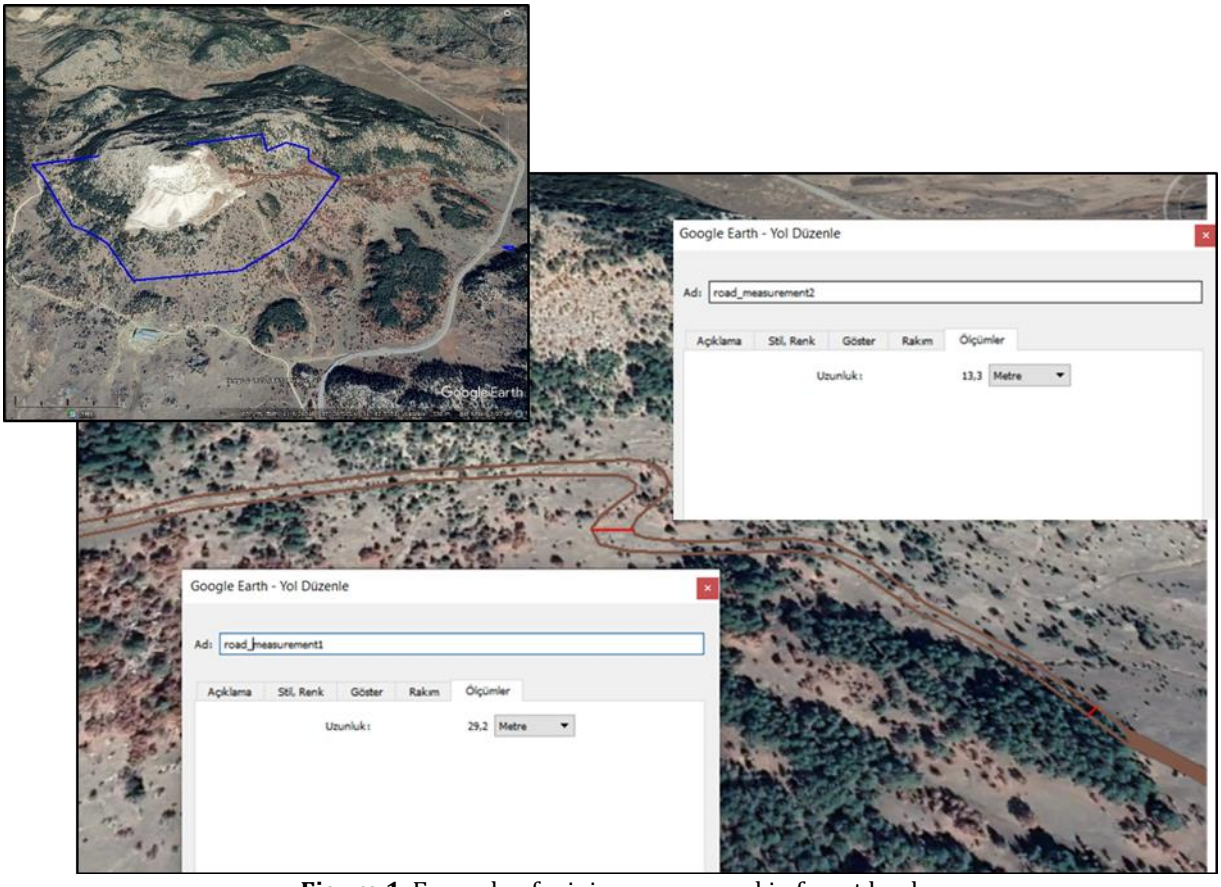

Figure 1. Example of mining access road in forest land

We measured the width of a mining access road in random site from google earth. When the widest and narrowest widths were measured, it was obvious that the widest was 29.2 m while the narrowest was 13.3 m. The geometric width standard of a Type-b Forest Road ranges between 3 and 5 m (6), so it was obvious that no standard was followed while planning and laying out this particular road. This particular example showed us that apparently no compliance was mandated and followed while constructing such roads.

Conclusion

When mining access roads are constructed without caring for the environment, the consequences will surely be detrimental. Mandating and strictly following a standard, Type-b Forest Road, will alleviate the additional adversities caused by these roads, the standard will also provide a judicial backing if non-compliance is sought. Without ravaging the topography, the shortest possible route, which will tie to the existing forest or village road network will diminish the adverse effects, considerably. Direct access demands to paved roads should not be allowed if linkage through other networks is possible.

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Intelligent digital twin for energy industry in AIoT networks

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Cite this study: İncekara, Ç. Ö. (2023). Intelligent digital twin for energy industry in AIoT networks. Advanced Engineering Days, 7, 36-40

Keywords
Industry 4.0
Internet of Things
Artificial Intelligence
Machine Learning
Digital Twins

Abstract

After industrial revolution the demand for the capacity and reliability of optical networks has continued to grow. Industries have become sources of numerous heterogeneous data. In order to handle these data/challenges, many issues need to be resolved, among which the low-margin optical networks design, power optimization, routing and wavelength assignment (RWA), failure management are quite important. Today Artificial Intelligence (AI), especially Machine Learning (ML), Digital Twins (DT) are regarded as one of the most promising methods to overcome the errors/problems that occurred at site. Intelligent systems make it possible to predict the behavior of highly complex production systems. Internet of Things -IoT- represents a new production reality. In the study interviews with experts on "Intelligent digital twin for Energy Industry in AIoT networks" are performed and Fuzzy MCDM based approach is developed. In the study 6 main criteria, i.e., Process Monitoring and Resource Optimization, Advanced Analytics, New Opportunities, Intelligent Grid, Cost-savings and Data Management, Sustainability and 34 related sub-criteria are evaluated by experts. Active digital twin is a solution that is carrying out a certain task on behalf of an object or under user assignment. Such form of digital twin is called intelligent information agent since it is already equipped with a certain form of artificial intelligence. It uses sensor devices and gateway connectivity to derive actionable insights and use them to develop new and advanced services for enhanced productivity.

Introduction

The Internet of things (IoT) describes physical objects (or groups of such objects) with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. IoT has had a significant impact on manufacturing, energy, agriculture, transportation, and other industrial sectors. The Industrial IoT (IIoT) is an industry-specific variant of the IoT, which provides an impressive potential for businesses via connected machines, sensors, and applications. It is one of the most exciting technologies now reshaping industrial enterprises, prompting them to modernize their processes, system intelligence, and facilities in order to cope with emerging disruptive technologies. IIoT improves manufacturing efficiency, safety, scalability, production time, and profitability in the industrial sector.

Recent advances in 5G & 6G-technology and IoT technology provide cost-effective approaches for wireless network connectivity between various sensors and processors in both industrial and commercial development. Wireless and portable electronics are undergoing explosive development, which is considered as a promising technology. In this regard, the application of various sensors makes it possible for the IoT sensor system to real-time collect data and transmit the sensor information to the cloud server using big data and artificial intelligence (AI) analysis. Therefore, a new data-driven product design model has recently emerged, which would make the design process more digitalized than ever before. Many studies have focused on the synergy between virtual reality (VR) and physical reality. In the physical world, the user's performance, behavior, and interaction with the other users will be captured by the sensor, and the actuators in the system will realize the feedback with the user. In the virtual world, the cloud will create corresponding virtual objects to visualize the structure of the object to better simulate the behavior of using the object. Traditionally, the construction, analysis, and upgrade of virtual

and physical objects will be separated from each other with a lack of a unified integrated analysis. Therefore, a new framework is needed in view of the data-driven product design, which can effectively realize the fusion and integration of various sensor data, hence prompting better interaction between virtual objects and physical objects. Virtual reality (VR) and augmented reality (AR) technologies are rapidly developing, which opens the door for a diversified range of applications in entertainment, virtual communities, personal healthcare, industrial design, surgical training, and many others.

The emerging "Industry 4.0" concept is an umbrella term for a new industrial paradigm which embraces a set of future industrial developments including cyber-physical systems (CPS), the Internet of things (IoT), the Internet of services (IoS), robotics, big data, cloud manufacturing and augmented reality. Industrial processes need most tasks to be conducted locally due to time delays and security constraints, and structured data needs to be communicated over the internet.

The Industrial Internet of Things-IIoT, is among the advanced manufacturing technologies collectively referred to is Industry 4.0, or the Fourth Industrial Revolution. Transforming the energy sector with IoT technology is an innovative way to promote improved productivity and recognize/arrange the consumption patterns to cut-short the excessive energy usage. In the energy sector, IoT devices have been able to create intelligent networks, i.e. Smart Grids, through the collection, transmission and use of large quantities of data. In this way, it integrates in an intelligent manner all of the assets connected to the network, optimizing operation and increasing the flexibility of the systems.

Transforming traditional factories into Smart factories via Smart Grids requires well-planned investments in advanced technologies such as IoT, AI and Digital Twin. Digital Twin Technology can help us to achieve Smart Factory by accelerating smarter decision making and autonomous operations, which reduces the time and cost associated with assembling, installing, and validating the factory's newer production process.

Digital Twin technology provides tools for the virtual representation of the potential new product design or production process. It plays a vital role in evaluating the product ideas before invest and adoption. A Digital Twin based Software Platform facilitates factories with digital footprints of physical products, which empowers organizations to predict outcomes precisely, detect physical issues, and develop efficient products.

What is Digital Twin?

David Gelernter was the first to mention the idea of digital twins in his book "Mirror Words" in 1991. But the concept and model of digital twin technology were first introduced publicly at a Society of Manufacturing Engineers conference by Dr. Michael Grieves in 2002. The Digital Twin platforms mirror the physical system, keep track of the real-time status, and keeps a complete record of the evolution a physical entity goes through.

The digital twin, as a further realization of VR and AR technology, was first practically defined by NASA in 2020 to improve physical model simulation for building the spacecraft. Digital Twin technology utilizes the historic product data to create futuristic simulations that further predict the capabilities of the Potential product or service. Digital Twin platforms incorporate multiple advanced technologies such as Artificial Intelligence, the Internet of Things, machine learning, and many more. There are Four types of Digital Twins: Parts Twining, Product Twining, System Twining, and Process Twining

In the past few years, digital twins have been put forward more in the concept of IoTs, which refers to the creation of a digital simulation in the information platform by supplementing AI, machine learning (ML), and software analysis. This simulation will be automatically modified accordingly based on the feedback from physical entity variations. The design of digital twin should be more dedicated to exploring applicability, that is, communication, collaboration, and coevolution between physical products and their digital representations (virtual products), toward more informed, expedited, and innovative design processes. With the help of various types of sensors, the realization of the digital twin has wider applications ranging from satellites, manufacture, to smart homes. After integrating enormous sensors with diversified functionalities distributed around the physical scene, the digital twin will form a virtual environment capable of monitoring the physical products and being managed via the IoT. Therefore, the development of various sensors is significant for the future realization of the digital twin. Currently, the sensors successfully applied in smart homes can be divided into the control interface of household appliances (e.g., voice control and self-powered interface control), environmental monitoring (e.g., gas leakage detection), and human activity tracking.

Microelectromechanical system (MEMS)/nanoelectromechanical system (NEMS), as the most commonly used micro-sensing devices, can convert various physical changes, such as humidity, lightness, temperature, pressure, motion, and acoustics changes into the changes of electrical signals. Therefore, MEMS-/NEMS-based sensors have always been an important part of wireless sensor networks. Notably, the wireless sensor network would require a large number of batteries to power those massive and distributed sensors. Therefore, it is very important to establish a sustainable wireless IoT sensing system by developing energy harvesters and self-powered sensors based on specific scenarios.

Material and Method

In the study; an integrated Fuzzy AHP- Fuzzy TOPSIS- Fuzzy VIKOR approaches are used to assess/evaluate Intelligent digital twin for Energy Industry in AIoT networks. In literature Fuzzy Multi Criteria Decision Making Methods (FMCDM) are used in different fields by many researchers [1-23] by using MATLAB program.

The study, i.e., "Intelligent digital twin for Energy Industry in AIoT network", measuring scale, consists of 6 dimensions-main criteria and 34 evaluation factors-sub-criteria are evaluated by decision makers (DMs). A questionnaire was developed following the methodology proposed for the below methods, which was answered by 29 experts/DMs.

Active digital twin is a solution/software that is carrying out a certain task on behalf of an object or under user assignment. Such form of digital twin is called intelligent information agent since it is already equipped with a certain form of artificial intelligence (AI). It uses sensor devices and gateway connectivity to derive actionable insights and use them to develop new and advanced services for enhanced productivity. It further improves real-time decision-making, complex operability, and overall experiences.

1. Process Monitoring and Resource Optimization: Using sensor devices in a power plant offers automated execution of the processes and render better services that are mostly error-free. IoT technology is a smart concept that also protects excessive resource utilization and helps maintain consistency. IoT allows smart process monitoring that gives every detail of the plant-process in the form of data.

2. Advanced Analytics: Sensor-based functioning of the power industry is bringing a revolutionary change. It uses advanced techniques to fulfill the business requirements and generate quality production. The industrialists are making the most out of using advanced analytics with their business. It uses sensor-enabled data to extract information from the assets and make better decisions than before. Data analytics helps the power sector to optimize generation and planning.

3. New Opportunities: IoT brings new business opportunities along with newer and advanced concepts. It involves sensor devices, gateway connectivity, and communication protocols that combine and form IoT architecture for multipurpose businesses. One can use IoT technology to avail business benefits and enable smart techniques for better productivity and growth. IoT is a futuristic technology, which empowers businesses through its real-time monitoring features, smart data management, and analytics.

4 Intelligent Grid: IoT provides a smart grid system to get control over the power flow or curb the energy consumption at significant levels. It further curtails the energy load to match the real-time generation or near real-time. IoT is an automated concept that offers a cost-effective approach to interconnect the users for effective power usage.

5. Cost-savings and Data Management: IoT in the energy sector is an advanced process that includes planning and energy management of the consumption patterns in multiple domains. It allows the managers to take complete control of energy data from scratch and optimize the process significantly. Using an IoT-powered solution in the energy sector utilizes sensor-based methods to establish the automated functioning of the industry.

6. Sustainability: All assets/machines/equipments have been made to talk to each other through IoT. The energy sector is the major driver of accountability that seeks smart ways to reduce environmental issues. IoT facilitates automated maintenance and reporting, optimization of smart grids, renewable energy generation, and measure carbon consumption in real-time. The technology is enabling sustainability around the industrial world through its smart techniques and is allowing the managers to make informed decisions for better business growth.

Internet of Things B2B

Internet of Things B2B solutions account for the majority of economic value created from IoT to date. In B2B settings, i.e., marrying IoT and AI can improve the predictive-maintenance capabilities of machines, while also empowering service providers to watch the health of their assets in real time, proactively addressing issues before a bigger breakdown occurs. B2B applications have grown faster than expected, particularly given the adoption of factory-automation solutions. However, through 2030, B2B applications are projected to nonetheless account for 62 to 65 percent of total IoT value. IoT provides the stated advantages; improved operational efficiency, better product quality and services, detail-oriented decision-making, cost-efficiency and increased Return on Investment (ROI), unlimited scalability, remote machine monitoring, accurate asset tracking, reduced power consumption, packet-switch services, real-time monitoring, time tolerance and control, geo-fencing, continuous data transfer, predictive maintenance.

Results

Sensor technology, big data and analytics are used to optimize operations, such as efficiently balancing supply and demand as customers connect to a smart grid. The usage of IoT in energy production helps to satisfy the energy demands in smart cities in an efficient way. However, a robust digital infrastructure is crucial for the roll-out of an architecture of connectivity and data.

The study, i.e., Intelligent digital twin for Energy Industry in AIoT network, i.e., measuring scale, consists of 6 dimensions-main criteria and 34 evaluation factors-sub-criteria are evaluated by decision makers (DMs). A questionnaire was developed following the methodology proposed for the below methods, which was answered by 29 experts/DMs.

After acquiring the fuzzy comparison matrices, importance weights of "intelligent digital twin's" dimensions; evaluation criteria is calculated by using Fuzzy method. According to the calculated criteria weights for "intelligent digital twin's" weights; the most important evaluation dimension/main-criteria is "Cost-savings and Data Management", the second important evaluation dimension is "Process Monitoring and Resource Optimization" and the third important evaluation dimension is "Advanced Analytics".

Conclusion

"Industry 4.0" concept has the flexibility to achieve interoperability between the different industrial engineering systems. To connect the different industrial equipment and systems, the same standards and safety levels are required. The "Industry 4.0" concept was born to apply the ideas of cyber-physical systems (CPSs) and IoT to industrial automation and to create smart products, smart production, and smart services. It involves cyber-physical systems, IoT, cognitive computing and cloud computing and supports what has been termed "smart factory". IoT technologies offer greater availability of information throughout the chain of value, allowing for amortization of better tools for decision making. IIoT is used to transfer the data from systems that monitor and control the industrial equipment to data processing systems that cloud computing has shown to be important tools for meeting processing requirements by using Wi-Fi, radio, satellite or cellular networks.

The growing integration of AI with functional electronics has spawned a new breed of intelligent systems capable of detecting, analyzing, and making decisions using machine learning algorithms. In addition, through the high transmission rate of 5G & 6G networks, the collection rate of the sensor data can meet the requirements of big data analysis and higher forms of AI. At the same time, the artificial intelligence of things (AIoT) as a combination of AI and IoT has become the most advanced technology, which can realize an intelligent ecosystem in a wide range of applications. When various sensors are combined with AI technology, the resulting intelligent systems can perform more complex and complete analysis on the gathered data sets than traditional methodologies. The accuracy of prediction can be increased by selecting appropriate algorithms, fine tuning algorithm parameters, and combining various types of data from different sensors. Digital-twin based intelligent systems have the potential to revolutionize the way we sense and interact, with applications as diverse as enhanced identity recognition, personalized healthcare monitoring, rehabilitation, robotic control, smart building, and encrypted interactions in VR and AR space.

Digital Twins is a technology that can synchronize digital environments with physical environments and reflects any changes that happen with actual products. The blend of Smart Manufacturing and Digital Twin Technologies can radically revise product designs, product manufacturing, usability, maintenance, and other aspects of manufacturing. Digital Twin Platforms enable factories to achieve Smart Factories with enhanced manufacturing planning and detailed production. The usage of digital twin boosts the achievement of the Smart factory. In line with the digital twin and smart manufacturing propels easy and accurate transformation of the traditional factory to the Smart Factory.

The application of AI will bring process automation and process optimization to a new level, due to its ability for inaccurate feature classification and prediction of sensor data, efficient processing of massive and dimensional datasets, and multimodal physiological signal analysis. Intelligent systems also make it possible to predict the behavior of highly complex production systems. On the other hand, digital twin-based intelligent systems will promote and fascinate the smart future.

The importance of the technology of digital twin as his significance stems from its simultaneous double benefit as a simulation and controlling tool. Creating virtual replicas of manufacturing flows, the whole factories, enterprises or supply-chains via passive model of digital twin enables enterprises to monitor, simulate and test established as well as hypothetical processes.

In the study interviews with experts on "Intelligent digital twin for Energy Industry in AIoT networks" are performed and Fuzzy MCDM based approach is developed. In the study 6 main criteria, i.e., Process Monitoring and Resource Optimization, Advanced Analytics, New Opportunities, Intelligent Grid, Cost-savings and Data Management, Sustainability and 34 related sub-criteria are evaluated by experts. After acquiring the fuzzy comparison matrices, importance weights of "intelligent digital twin's" dimensions; evaluation criteria is calculated by using Fuzzy method. According to the calculated criteria weights for "intelligent digital twin's"

weights; the most important evaluation dimension/main-criteria is “Cost-savings and Data Management”, the second important evaluation dimension is “Process Monitoring and Resource Optimization” and the third important evaluation dimension is “Advanced Analytics”.

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Prostate lesion segmentation from MR images using deep learning methods

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Cite this study: Erkuş, İ., Bayram, B., Uzar, A. M., & Çakar, T. (2023). Prostate lesion segmentation from MR images using deep learning methods. Advanced Engineering Days, 7, 41-43

Keywords
Deep Learning
Prostate MRI
DeepLabV3+
Lesion Detection

Abstract

Prostate cancer is a prevalent form of cancer in men, emphasizing the need for accurate and efficient methods for prostate lesion segmentation from magnetic resonance (MR) images. Manual segmentation of prostate lesions is time-consuming and subjective, highlighting the significance of automated approaches using deep learning methods. This study presents a comprehensive investigation into applying deep learning techniques for prostate lesion segmentation from MR images. The study explores state-of-the-art deep learning models, including U-Net, PAN, DeepLabV3, DeepLabV3+ for segmentation. A large PICAI dataset of prostate MR images, comprising multi-parametric MRI scans and expert annotations, is utilized for evaluating the developed methods. Performance metrics such as accuracy, precision, recall, specificity, accuracy, IOU, AP Score, PR curve, and AUC curve were employed to compare the proposed deep learning methods. In summary, this research contributes to the field of prostate lesion segmentation by investigating the effectiveness of deep learning methods applied to MR images. The DeepLabV3+ model achieves an IOU of 0.79 and an AP of 0.54 using Jaccard Loss.

Introduction

Prostate cancer is one of the most prevalent forms of cancer affecting men worldwide. Prostate cancer incidence increased by 3% annually from 2014 to 2019, resulting in 99,000 additional cases [1]. Magnetic Resonance Imaging (MRI) has emerged as a powerful imaging modality for the non-invasive evaluation of prostate cancer. However, the manual segmentation of prostate lesions from MRI scans is a time-consuming and subjective task, heavily reliant on the expertise of radiologists.

This study aims to present a comprehensive review of deep-learning methods for prostate lesion segmentation from MR images. The proposed study will investigate state-of-the-art deep learning architectures specifically tailored for prostate lesion segmentation. We will explore various models DeepLabV3+, DeepLabV3, and U-Net which have shown promising results in medical image segmentation.

Karagoz et al [2] state that their method achieves top results in the open-validation stage of the PI-CAI 2022 Challenge, with an AUROC (Area Under the Receiver Operating Characteristic curve) of 0.888 and AP (Average Precision) of 0.732. These evaluation metrics indicate the effectiveness of the proposed workflow in accurately detecting clinically significant prostate cancer using bi-parametric MRI.

Material and Method

The PI-CAI dataset [3] contains 1500 prostate bi-parametric MRI scans obtained between 2012-2021 from three medical centers in the Netherlands. The objective of the PI-CAI challenge is to assess the effectiveness of AI algorithms and radiologists in detecting and diagnosing clinically significant prostate cancer based on the provided imaging data.

To download the associated imaging data, visit [4]:

Table 1. Information About PI-CAI Dataset

Number of MRI scanners	5 Siemens Healthineers, 2 Philips Medical Systems Number
Number of patients	1476
Number of cases	1500
Benign or indolent PCa	1075
csPCa (ISUP ≥ 2)	425

Data Preparation

The PI-CAI dataset have 1500 prostate bi-parametric MRI scans data in total. 425 out of 1500 data are malignant. Among the 1075 data, there are indolent (with a tag value of 0) and benign ones. There are 391 indolent. We didn't use it. Those who have a 0 tag are of no use to us in training. 684 of them remained benign.

Table 2. Information About Our Dataset

Number of cases	1109
Number of malignant	425
Number of benign	684

T2, diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) images were used. As part of the preprocessing step for the lesion segmentation/detection models, all images were converted from MHA (.mha) format to numpy(.npy). By converting the images to the appropriate format, they could be seamlessly integrated and processed within the deep learning framework for effective lesion segmentation and detection.

Buslaev et al. [5], which is a library specifically designed for image augmentation. Image augmentation is a technique commonly used in machine learning and computer vision tasks to artificially increase the diversity of a dataset by applying various transformations to the images. These transformations can include rotations, translations, scaling, cropping, flipping, color adjustments, and many others. In this study, lambda transform is used for preprocessing the dataset.

The train image size is 809, test image size is 150, validation image size is 150.

Parameter

Lesion segmentation was carried out using different numbers of epochs, learning rates, and batch sizes. In addition, using loss functions such as BCEWithLogitsLoss, JaccardLoss, DiceLoss, and FocalLoss.

Metrics

The following metrics were calculated in order to compare the predictions of the model: F1 Score, Recall, Specificity, Accuracy, IOU (Intersection over Union), PR (Precision-recall) curve, AUC Curve, AP (Average Precision) Score.

Implementation Details

All experiments were conducted on a PC, which provides an NVIDIA GEOFORCE GTX 1650 GPU with 12GB memory.

Results

Metrics: Epoch: 200, Learning_rate: 0.001, Batch_size: 16 (Exception: Segformer batch size is 8), Image_size: 256, Metric: IoU, Seed: 42, Optimizer: Adam.

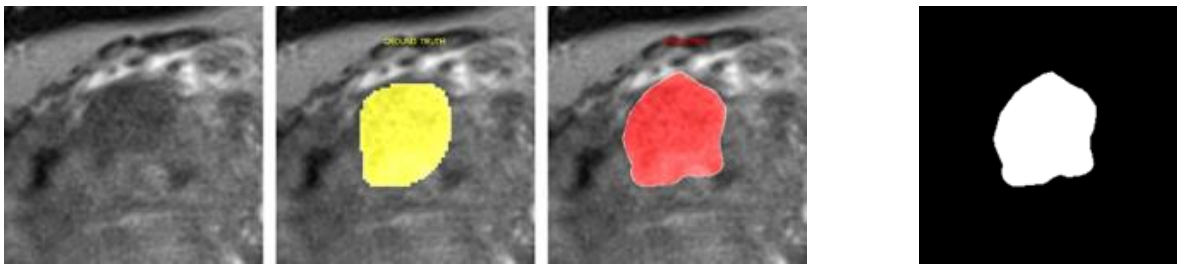

Figure 1. DeepLabV3 with BCEWithLogitLoss, IOU:0.7938

Table 3. The comparison of lesion segmentation results

No	Model	Loss	Best Epoch	Total Time	F1 Score	Precision	Recall	Specificity	Accuracy	IOU
1	DeepLabV3+	jaccard_loss	58	2 hours 138 minutes 13 seconds	0.8707	0.8893	0.8815	0.9817	0.9556	0.7911
2	DeepLabV3	BCEWithLogitLoss	67	4 hours 285 minutes 16 seconds	0.8727	0.8791	0.8942	0.9783	0.9557	0.7938
4	UNET	jaccard_loss	16	2 hours 144 minutes 12 seconds	0.8615	0.8900	0.8665	0.9827	0.9529	0.7807

The DeeplabV3+ model achieves an IOU of 0.79 and an AP of 0.54 using JaccardLoss. The Deeplab V3+ achieved the best score of AP (Average Precision) of 0.54.

Table 4. The comparison of lesion segmentation results (AP Score)

Model	**Loss Function**	**Average Precision (AP) Score**
DeeplabV3+	JaccardLoss	0.5430835551263445
DeeplabV3	BCEWithLogitsLoss	0.5363376783531771
UNET	JaccardLoss	0.531243452000525

Discussion

The study explores state-of-the-art deep learning models and evaluates their performance using a large dataset of prostate MR images. On the PICAI dataset, different three models were used to train. The DeepLabV3 model achieves an IOU of 0.79 and an AP of 0.53 using BCEWithLogitLoss and the prediction time is approximately 4 hours. DeepLabV3+ model achieves an IOU of 0.79 and an AP of 0.54 using JaccardLoss and the prediction time is approximately 2 hours.

Conclusion

The article contributes to the research for prostate lesion segmentation by comparing three different models and concluded that DeeplabV3+ deep learning method can be effective for prostate lesion segmentation from MR images.

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Detection of Alzheimer's Disease using deep learning algorithm

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Cite this study: Alhamidi, M. (2023). Detection of Alzheimer's Disease using deep learning algorithm. Advanced Engineering Days, 7, 44-46

Keywords
Alzheimer's disease
Magnetic resonance imaging
Convolutional Neural Network
Images classify

Abstract

Alzheimer's disease (AD) is a prevalent neurodegenerative disorder affecting a significant portion of the elderly. Timely and accurate detection of AD is crucial for effective management and intervention. Deep learning algorithms have shown promising results in medical image analysis, including diagnosing AD using magnetic resonance imaging (MRI) scans. This study aims to compare the performance of various deep learning architectures, namely CNN (Convolutional Neural Network) for AD detection on MRI images. A large dataset comprising MRI scans from AD patients and healthy controls is utilized for model training and evaluation. The deep learning models are trained to automatically learn discriminative features from the MRI images. Performance evaluation metrics such as accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve (AUC-ROC) are used to assess and compare the models' performance. This study provides insights into the suitability to show the ability of preference of this algorithm. The findings can aid in selecting the most appropriate algorithm for AD diagnosis based on specific requirements, such as accuracy, computational efficiency, and resource availability. Further investigation and validation on more extensive and diverse datasets are necessary to establish the generalizability and clinical viability of these algorithms for AD detection in real-world settings.

Introduction

Alzheimer's disease (AD) is a progressive neurodegenerative disorder that affects millions of people worldwide. Early and accurate detection of AD is crucial for effective management and intervention. In deep learning, particularly in the context of Alzheimer's disease detection, convolutional neural networks (CNNs) are commonly used. CNNs are a type of deep learning algorithm designed to analyze visual data, such as images, by automatically learning and extracting relevant features. In recent years, deep learning algorithms, particularly Convolutional Neural Networks (CNNs), have shown promise in medical image analysis, including diagnosing AD using magnetic resonance imaging (MRI) scans [1][2]. This study aims to develop and evaluate a CNN-based deep learning algorithm for the detection of AD using MRI images.

Material and Method

Participants and Datasets

In this study, the participants and datasets were obtained from the Kaggel Alzheimer's Dataset. The dataset comprises MRI images and is divided into four classes: Mild Demented, Moderate Demented, Non-Demented, and Very Mild Demented. Both the training and testing sets include images representing each severity level of Alzheimer's. The dataset is organized into two files: Training and Testing. Each file contains approximately 5000 images, resulting in a total dataset size of around 10,000 images. The images are segregated based on the severity level of Alzheimer's disease, to analyze the impact of different severities on the classification task or other relevant analyses [3].

MRI Preprocessing

The dataset used in this study consists of MRI images from AD patients and healthy individuals. The dataset is preprocessed to ensure uniformity and remove any artifacts or noise. A CNN architecture is designed, implemented, and trained using MRI images. The CNN learns to automatically extract relevant features from the images and classify them as AD-positive or AD-negative. The training process includes optimization techniques such as stochastic gradient descent and backpropagation [4].

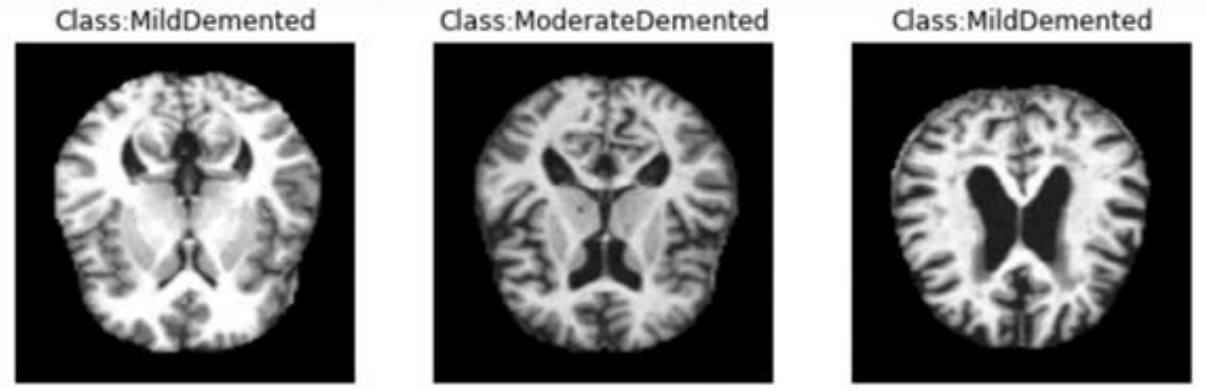

Figure 1. Example of the MRI scan after applying preprocessing

This image processing sets up an image data generator with various augmentation techniques such as zooming, brightness adjustment, and horizontal flipping. It rescales the pixel values of the images and defines the data format for the generated image batches. The train_data_gen is then created using this data generator to generate augmented image batches from a specified directory [4].

Data Augmentation

The augmented images were then combined with the original training dataset, effectively increasing the sample size. This larger dataset allowed for a more comprehensive representation of the data, enabling the CNN models to learn from a wider range of examples. By incorporating augmented data, we aimed to mitigate the risk of overfitting and enhance the generalizability of the models, enabling them to perform better on unseen data. [1].

By employing augmentation techniques and merging the augmented images with the original dataset, we sought to address the challenges associated with limited sample sizes and potential image variations. This approach aimed to enhance the training process of robust CNN models for improved performance in image analysis tasks.

Convolutional Neural Network

In summary, the construct model function defines a CNN architecture using the Keras Sequential API, consisting of convolutional layers, max-pooling layers, dropout layers, and dense layers. It is designed for classification tasks and can be customized by specifying different activation functions through the act parameter.

Results

The trained CNN model is evaluated using performance metrics such as accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve (AUC-ROC). The results demonstrate the effectiveness of the CNN in accurately classifying the MRI images as AD-positive or AD-negative. The model achieves high accuracy and sensitivity, indicating its potential as a reliable tool for AD detection [5].

Table 1. Trained CNN model

	precision	recall	f1-score	support
NonDemented	0.95	0.98	0.97	639
VeryMildDemented	1.00	1.00	1.00	635
MildDemented	0.94	0.88	0.91	662
ModerateDemented	0.90	0.93	0.92	624

In the given output, we have a classification report for a multi-class classification problem with four classes: NonDemented, VeryMildDemented, MildDemented, and ModerateDemented. Let's break down each metric and its interpretation for each class: Precision: A high precision indicates that the model has a low rate of false positives.

Recall: It measures the ability of the model to capture positive instances. F1-score: The F1-score is the harmonic mean of precision and recall. It provides a single metric that balances both precision and recall, giving an overall performance measure. Support: Support refers to the number of occurrences of each class in the dataset.

Discussion

The results indicate that the CNN-based deep learning algorithm shows promising performance in detecting AD using MRI images. The ability of the CNN to automatically learn discriminative features from the images contributes to its high accuracy. The utilization of CNNs in medical image analysis leverages their ability to capture spatial dependencies and hierarchical representations, making them well-suited for AD detection.

The comparison of different CNN architectures, such as variations of ResNet, DenseNet, and Inception, can provide insights into their respective strengths and limitations. Evaluating factors such as computational complexity and performance metrics can aid in selecting the most suitable architecture for AD detection on MRI images.

Conclusion

In conclusion, this study demonstrates the potential of CNN-based deep learning algorithms for the detection of AD using MRI images. The developed model achieves high accuracy and sensitivity, showcasing its effectiveness in discriminating between AD patients and healthy individuals. The utilization of deep learning techniques in AD diagnosis has the potential to revolutionize the field by providing clinicians with a reliable and objective tool for early and accurate detection. Further research and validation on larger and more diverse datasets are warranted to establish the robustness and generalizability of the proposed algorithm. The integration of deep learning algorithms into clinical practice holds great promise for improving patient outcomes and advancing our understanding of AD.

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Potential analyses of LiDAR-based automatic powerline detection algorithms

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Cite this study: Nazar, M., Sefercik, U. G., & Aydın, I. (2023). Potential analyses of LiDAR-based automatic powerline detection algorithms. Advanced Engineering Days, 7, 47-49

Keywords
Powerline detection
LiDAR
Point cloud
Aerial systems
Disaster monitoring

Abstract

Powerlines are utilized for distributing electricity for household use, industry, healthcare purposes and etc. The detection of powerlines is an important topic in object detection studies. In addition, overgrown trees in dense forest regions may pose a risk for powerlines positioned in these regions and even may cause forest fires if unattended. So, it is also important in the scope of disaster monitoring research and studies. Light detection and ranging (LiDAR) systems are utilized for the detection of powerlines in urban regions and forests with the ability to obtain high-resolution point cloud data. Also, with the operation principle based on active remote sensing aerial LiDAR systems with multi-return capability can be used to obtain information about forest understory and is more effective compared to optical systems in this context. In this study, aerial LiDAR point cloud data of an urban region was utilized for the automatic detection of powerlines. For the automatic detection of powerlines, Robust Railroad Infrastructure Detection Framework which was developed by Eötvös Loránd University (ELTE) Geoinformatics Laboratory was utilized and five algorithms including Above, AngleAbove, AngleGroundAbove, VoronoiAbove, and VoronoiGroundAbove are applied separately on LiDAR point cloud data. When results are analyzed visually AngleAbove gave the best results in powerline detection.

Introduction

Powerlines are utilized in the distribution of electricity in towns, cities, and countries for general household usage, industrial requirements, healthcare, agriculture, etc. However, rapid urbanization and overgrowth in forests can pose a significant risk for powerlines in urban and rural regions. Also, sudden changes in wind speeds can cause powerline induced fires in wildlands due to the ignition of broken lines by contact with trees [1]. So, the inspection of powerlines especially in high-risk regions is an important topic in the scope of disaster monitoring. Presently, powerline corridor management in forest regions primarily consists of detecting and trimming trees with high risk which could fall and cause damage to the structure, and using conventional men-centric monitoring methods is time-consuming, includes high cost, and is a hazardous work process [2]. However, instead of using the conventional powerline monitoring method airborne light detection and ranging (LiDAR) technique which has the ability to generate densely populated three-dimensional (3D) point clouds in a short time and with less cost, can be utilized in powerline detection. Moreover, utilizing airborne LiDAR point clouds high-quality digital surface models (DSM) can be produced with high geolocation accuracy [3-4]. LiDAR systems are utilized in disaster monitoring studies such as detecting the spatial distribution of wildland fuel types and properties for forest fire management, observing characteristics of aerosol particles that emerged as a result of volcanic eruptions using LiDAR measurements, estimation of 3D coseismic displacement after earthquake and detection of collapsed buildings due to earthquake from LiDAR DSM and automated power line extraction from airborne LiDAR point cloud in forest areas [5-8]. In this study, Robust Railroad Infrastructure Detection Framework which was developed by Eötvös Loránd University (ELTE) Geoinformatics Laboratory was used for the automatic detection of powerlines in an aerial LiDAR point cloud. Five algorithms namely Above, AngleAbove, AngleGroundAbove, VoronoiAbove, and VoronoiGroundAbove are applied individually on point cloud data to see the results of different detection algorithms and to determine which performs better when analyzed visually.

Material and Method

A point cloud which was obtained by aerial LiDAR surveys was utilized for the automatic detection of powerlines in an urban area where there are different land cover classes including powerlines, buildings, roads, and vegetation. Point cloud data was large in size so for the test study it was scaled down to a strip with a length of approx. 1.25 km and a point number of nearly 3.8 million (Figure 1).

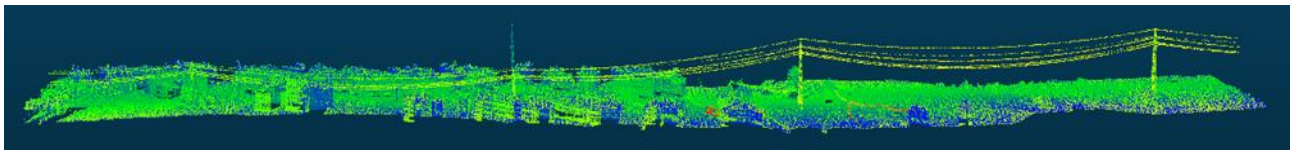

Figure 1. LiDAR point cloud of the study area

For the automatic detection of powerlines in the study area Robust Railroad Infrastructure Detection Framework which is a software library and a tool for automatic rail track and cable detection from LiDAR point clouds, was utilized. The automatic detection tool includes filtering algorithms for reducing the size of the point cloud and projection filters for generating a two-dimensional projection of the original 3D point cloud to minimize the computational load during the detection process [9]. Five algorithms such as Above, AngleAbove, AngleGroundAbove, VoronoiAbove, and VoronoiGroundAbove are applied separately on point cloud data. Applying these algorithms, a probabilistic Hough line detection algorithm is applied after the projection phase. The probabilistic Hough transform is given in Equation (1) [10].

$$H(\vec{y}) = \sum_{i=1}^{n} \ln[f(\vec{x}_i|\vec{y})] + \ln[f_0] + C \quad (1)$$

Where n is the number of input features, $\vec{x}_i$ is a specific image measurement, $\vec{y}$ is a specific point in Hough space, $f(\vec{x}_i|\vec{y})$ is the probability density function of $\vec{x}_i$ given the value of $\vec{y}$, f_0 a priori probability density function and C is the arbitrary constant.

Results

The results of the applied detection algorithms are presented in Figure 2.

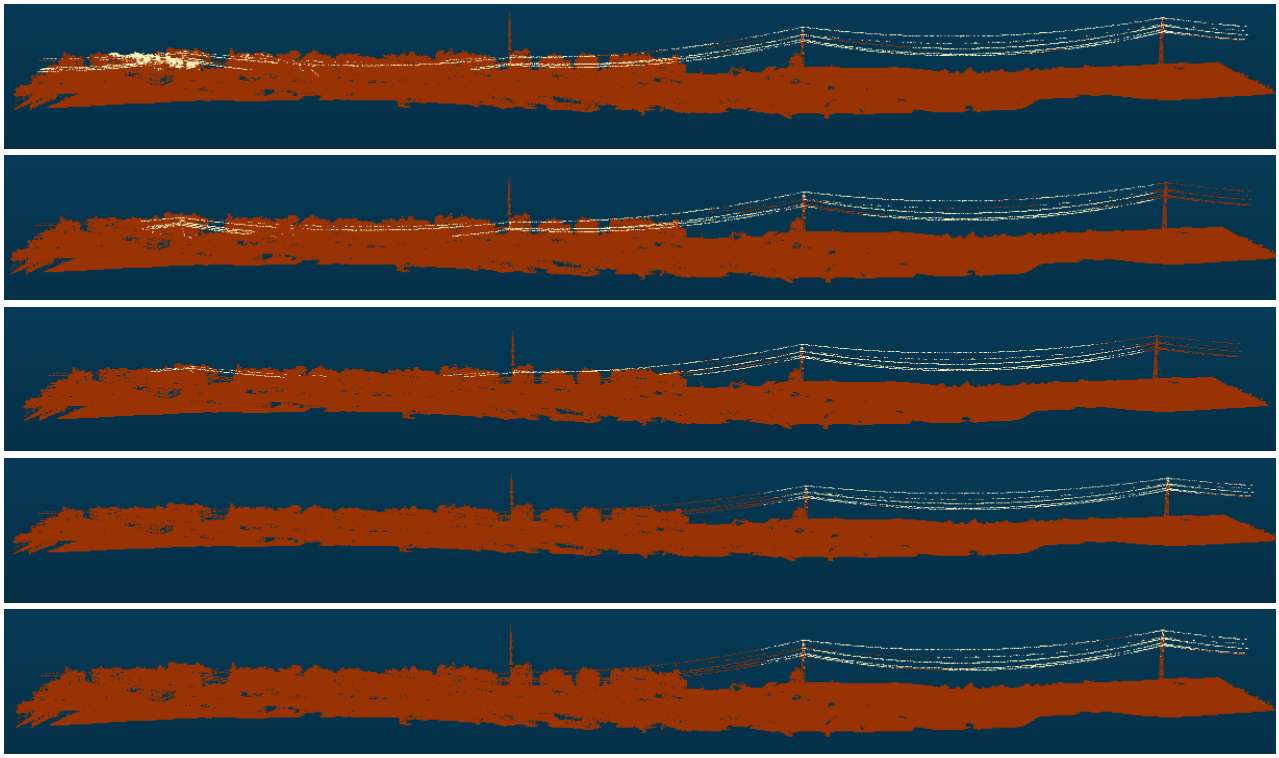

Figure 2. Results of the applied detection algorithms Above (a), AngleAbove (b), AngleGroundAbove (c), VoronoiAbove (d), and VoronoiGroundAbove (e). Detected powerline points are in yellow color.

When the results are visually analyzed AngleAbove algorithm performed better compared to other detection algorithms. VoronoiAbove and VoronoiGroundAbove algorithms performed worse than other ones whilst detecting only a limited number of powerline points. Above and AngleAbove algorithms gave similar results while the Above algorithm incorrectly detected other object points as powerline points compared to AngleAbove. AngleGroundAbove gave average results between other algorithms. In parts of the point cloud where points of other land cover classes including buildings, and vegetation are existing, the performance of detection algorithms was decreased.

Conclusion

Various disaster monitoring studies are carried out using LiDAR systems and the results obtained can be used by decision makers in disaster prevention and post-disaster recovery and rehabilitation. It has been observed that the AngleAbove detection algorithm, which is applied within the scope of the Robust Railroad Infrastructure Detection Framework for the detection of powerlines, has a higher success in visual analysis compared to other algorithms. It has been observed that detection algorithms give different results depending on the topography and object structure. It is understood that detection algorithms give different results depending on the topography and object structure.

Acknowledgments

We would like to thank EMİ Group Information Technologies for aerial LiDAR point cloud data and ELTE Geoinformatics Laboratory, Máté Cserép and Péter Hudoba for Robust Railroad Infrastructure Detection Framework.

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Cultural landscape elements of Pire (Şeyh) Merdan first degree archaeological site, Mardin

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Cite this study: Karataş, L., Alptekin, A., & Yakar, M. (2023). Cultural landscape elements of Pire (Şeyh) Merdan first degree archaeological site, Mardin. Advanced Engineering Days, 7, 50-54

Keywords
Sanctuary
Cultural heritage
Documentation
Pire Merdan
Mardin

Abstract

Pire Merdan is a site located within the boundaries of Elmabahçe Neighborhood in the Artuklu district of Mardin province. Also known as Tizyan Roman Settlement, this area was registered as I. Degree Archaeological Site under Law No. 2863 in 2018, due to its status as a valuable immovable cultural heritage site requiring protection. The site contains numerous elements of historical architecture and archaeological significance. There is a lack of information and documentation regarding this area, which holds such significant historical, archaeological, and religious values. Therefore, the purpose of the presented paper is to contribute to the literature by documenting the archaeological, architectural, and religious elements of the sacred settlement area of Pire Merdan. The area was examined and photographed on-site for this study. The architectural features of the site were described and documented through the use of photographs. Further detailed investigations to be conducted in the future, estimating back to prehistoric periods, will provide clear conclusions both for archaeological literature and the history of the region.

Introduction

Mardin is a historical city located in the southeast of Türkiye. Known for its cultural and historical heritage, Mardin is also home to several sacred sites. One of the significant sacred areas in Mardin is Pire Merdan. Pire Merdan, also known as Tizyan Roman Settlement, is situated within the boundaries of Elmabahçe Neighborhood in the Artuklu district of Mardin province. Due to its status as a valuable immovable cultural heritage site requiring protection, the area was registered as a first-degree archaeological site under Law No. 2863 in 2018 [1].

The site is located in a valley approximately 2 km northeast of the settlement area. The terrain is mountainous, with fertile agricultural fields present. The geography, rich in water resources, has served as a settlement area in different periods of history [1].

This paper introduces the architectural, religious, and archaeological elements of Pire Merdan, a first-degree archaeological site and an important sacred area in Mardin.

Material and Method

In the first stage, a detailed photographic method was employed to investigate the architectural elements of the Pire Merdan Sacred Area in Mardin. Researchers visited the site and conducted thorough documentation through photography. In the second stage, explanations were provided using the photographs to introduce and describe the architectural features and elements of the area.

Results

Archaeological remains from the prehistoric period

It has been reported by the local population that there is a significant presence of flint stones, some of which are worked, on the dominant hill approximately 1 km walking distance southeast of the Pire Merdan site. It is estimated that the flint stones and nodules identified on the surface in the Pire Merdan settlement area were brought from this location. The most significant evidence of carrying traces of different cultures has been identified through surface examinations. Although the flint stones and tools identified on the surface near the location used as a pool may not be densely concentrated, they can be dated back to the prehistoric period (Figure 1).

Figure 1. The stones presumed to belong to the prehistoric period

Cave

Approximately 130 meters northeast of the section where the pool is located and about 70 meters southwest of the Pire Merdan Tomb, there is a rectangular-shaped cave structure carved into the main rock. The entrance to the cave structure is accessed through a 5-meter-long and 2-meter-high opening. Inside the cave structure, the inner part is carved into the main rock. The ceiling and walls are smoothly carved, and there are decorative arches, presumed to be embossed lintels, on the inner walls. These lintels are believed to be decorative elements that continue at the same level along the walls. At the end of the cave, there is a chimney-like architectural feature in the center of the ceiling. This suggests that it may have been used as a healing center or a place of worship during that period. The roof part of the cave is flat, and the chimney feature is covered with molded and processed stone (Figure 2, 3).

Figure 2. The exterior view of the cave structure

Figure 3. Interior detail photos of the cave structure

Remains of Roman-era architectural structures

Approximately 60 meters northwest of the cave structure, there are rectangular-shaped architectural remains that are presumed to belong to the Roman period. Some of the stones have been worked, indicating their association with the architectural structure in the area. Adjacent to the architectural remains, there is a damaged monolithic stone in the form of an obelisk, which is believed to be part of the same structure (Figure 4).

Figure 4. The stone structure in the form of an obelisk

There is an approximate distance of 10 meters between these architectural remains and the tomb. The remains are located in the western section of the tomb structure (Figure 5).

Figure 5. Archaeological architectural remains

Tomb

The tomb, located at the center of the site, is one of the most impressive architectural elements of the Pire Merdan Sacred Area. The tomb structure is oriented in a north-south direction and has a square-like plan with an open courtyard. It is constructed with rubble stone materials. The top of the structure is covered with a stone dome that is rounded downwards and tapers towards the top like a cone. The main entrance to the structure is provided through an iron gate with lintel-like forms located on the eastern facade. Above the gate, there is a square-shaped window at the top. Inside the space, in the southern section, there is the tomb sarcophagus belonging to Sheikh Merdan, extending east-west. The interior space is plastered with lime mortar and painted with white lime wash. The entrance to the tomb courtyard is through the lintel-shaped gate on the east side. The northeastern part of the courtyard is elevated in a terrace-like manner and used as a garden with trees. South of the gate entrance, there is a small area built with brick material. The external facades of the structure are made of concrete and painted with a synthetic green color. According to information obtained from the local villagers, it is mentioned that Pire Merdan is one of the twelve disciples of Sultan-Şeyhmus (Sheikh Mussa Ezzuli), who holds great importance in the region (Figure 6, 7).

Figure 6. Exterior details of the tomb structure

Figure 7. Interior details of the tomb structure

Conclusion

This paper examines the architectural features and elements of the Pire Merdan First Degree Archaeological Site, which is an important sacred area in Mardin. The architectural elements found in the area include stones presumed to belong to the prehistoric period, rectangular-shaped architectural remains believed to be from the Roman period, an obelisk, one cave structure, and tomb elements. When considering the site as a whole, it becomes evident that it has maintained continuity with distinct metaphors of different belief systems from ancient times onwards. Based on this notion, it strengthens the thesis that the settlement has been a sacred space where various rituals have been performed throughout its history.

During the months of September and October, the Pire Merdan Sacred Visitation area is visited intensively by local tourists. The site is located on a high hill, offering a panoramic view of the city. It is crucial to promote tourism in an area that possesses such significant historical, architectural, and archaeological elements while ensuring the preservation and sustainability of its landscape features. The documentation and inclusion of the site in the literature, as carried out in our study, are important initial steps. For future research, it is recommended to utilize technological tools such as terrestrial laser scanning or UAVs (Unmanned Aerial Vehicles) for three-dimensional documentation of the area [2-8]. Creating online virtual tours for tourism purposes can be achieved by documenting the site in 3D with these tools. Additionally, the three-dimensional documentation of the structure will serve as a valuable resource for experts during the restoration phase, providing a reference to the original state of the area in the event of any damage or loss in subsequent stages [9-15].

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Stone material damage detection in restoration using terrestrial laser scanning (LiDAR): The case study of Karacabey Government Mansion in Bursa, Türkiye

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Cite this study: Karataş, L., Alptekin, A., & Yakar, M. (2023). Stone material damage detection in restoration using terrestrial laser scanning (LiDAR): The case study of Karacabey Government Mansion in Bursa, Türkiye. Advanced Engineering Days, 7, 55-59

Keywords
Remote sensing
TLS
Architectural surveys
Cultural heritage
Bursa

Abstract

Combining observational examination and terrestrial laser scanning (TLS) techniques is a highly effective method for documenting the architectural features of cultural heritage structures. These techniques have been increasingly used in recent years to create detailed and accurate plans, elevations, dimensions, and details of the structure. The purpose of this presented paper is to utilize the data obtained from observational examination and terrestrial laser scanning to produce survey drawings and reports of the historic government mansion located in the Karacabey district of Bursa, Türkiye. The study aims to reveal information about the current state of the structure and its historical evolution over time. Through the study, the final condition of the structure, as it has evolved from the past to the present, has been determined, and floor plans and reports have been prepared. Consequently, the floor plan architectural drawings of the structure have been projected as analytical surveys, providing information about its current state for future restoration efforts.

Introduction

Terrestrial laser scanning (TLS) relies on the emission and collection of laser beams around the structure using a laser scanner. The scanner sends thousands of laser points to the structure and measures the reflection time of the points to obtain distance information [1-3]. This process allows the creation of a 3D point cloud of the structure. Observational laser scanning enables the precise documentation of the external facade, roof, windows, and other details of the structure [4-7]. Terrestrial laser scanning is performed from a ground vehicle or a fixed point, typically covering larger areas and surrounding structures. It operates similarly to observational laser scanning, generating a 3D point cloud. This method is used to document the surrounding area and the overall appearance of the structure [8-12].

The combination of observational and terrestrial laser scanning techniques allows for the detailed documentation of both the interior and exterior spaces of structures. These methods can also be used to detect deformations, damages, or other changes in addition to architectural features [13-15].

In this context, the aim of the study is to utilize the data obtained from terrestrial laser scanning to generate survey drawings and reports of the historic government mansion located in the Karacabey district of Bursa, Turkey, providing information about its current state. As a result of the study, the final condition of the structure, as it has evolved from the past to the present, has been determined through drawings and reports.

Material and Method

The methodology adopted for the creation of analytical surveys of the identified structure involved literature research, observational examination, and terrestrial laser scanning. The gathered information was evaluated using descriptive and systematic analysis methods.

In the initial phase of the research, a situational analysis was conducted to gather general information about the historical structure to be studied. This included an archival search and the presentation of data obtained from the Bursa Karacabey Municipality archives. Additionally, an observational analysis of the structure was carried out to document material issues.

The combination of these methods allowed for a comprehensive understanding of the architectural features, conditions, and material problems of the structure. The data collected served as the basis for the subsequent steps of the study, such as the creation of survey drawings and reports.

The systematic steps followed for documenting material deteriorations of the structure using methods derived from terrestrial laser scanning are presented in this section after the assessment of the current condition of the building.

Before proceeding with the scanning process in the field, it is necessary to plan the scanning operation. During the planning stage, the locations and number of stations for scanning need to be determined.

The locations of the scanning stations should be determined adequately to cover the entire building and all its details. In this study, for the scanning of the exterior of the Bursa Karacabey Government Mansion, 11 station locations were designated. In the study, the first scanning station was selected as the instrument-centered coordinate system, which served as the project coordinate system. The point cloud data obtained from all other stations were transformed into this coordinate system. After the data cleaning process, a 3D point cloud encompassing the entire structure was generated. In this stage, terrestrial laser scanning was employed for documenting the Bursa Karacabey Government Mansion. The structure was scanned using a terrestrial laser scanning device (Faro Focus Laser Scanner), and point cloud data were obtained from the scanning process.

In this section, the detailed steps followed for generating orthophotos using point cloud data are provided. The point cloud data obtained from the laser scanning process was processed using software called PointCab Origins 4.0 to obtain the 3D images of the structure (Figure 1). In the next stage, using the PointCab Origins 4.0 software, cross-sections were extracted from the 3D images of the structure at desired locations, resulting in the production of orthophotos depicting the building (Figure 2).

In the next step, the AutoCAD software was used to create architectural drawings. Before the drawing process, the orthophoto images generated in PointCab Origins 4.0 software were transferred to the AutoCAD environment. The orthophoto images were imported into AutoCAD as TIF (Tagged Image File) format, which is a common data format for AutoCAD software. Using the scaled orthophoto images, the AutoCAD program was utilized to obtain the building's elevation drawings.

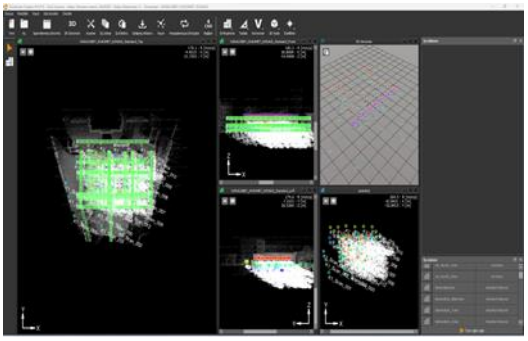
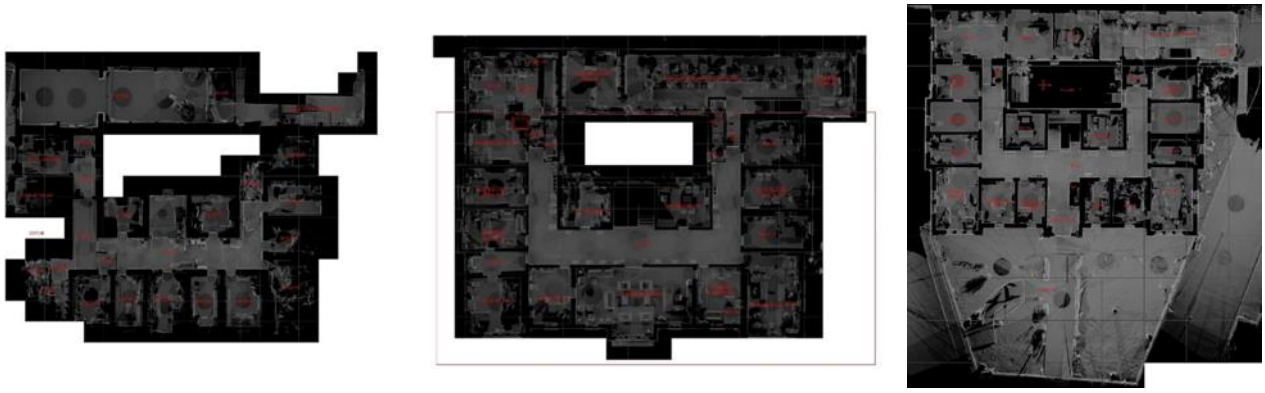


Figure 1. An example scene from obtaining scaled orthophotos of the building using the PointCab Origins 4.0 software



(a) (b) (c)

Figure 2. Obtaining scaled orthophotos of the building's floor plans using the PointCab Origins 4.0 software: a) Basement floor plan orthophoto, b) Ground floor plan orthophoto, c) First floor plan orthophoto

Results

After evaluating the macro and micro visual observations conducted in the previous section, along with the current condition analysis of the building or monument, and the comparative analysis of the elevation drawings obtained from laser scanning-derived orthophotos, the following findings have been reached:

Architectural features of the basement floor

The structure was originally built in a "U" plan type. However, due to the later addition of the Population Directorate, it can be described as a square-planned structure with a courtyard. In the current condition, the basement floor exhibits spaces belonging to the southern structure group (Population Directorate Archive B24, Room B25, Storage B26) (Figure 3).

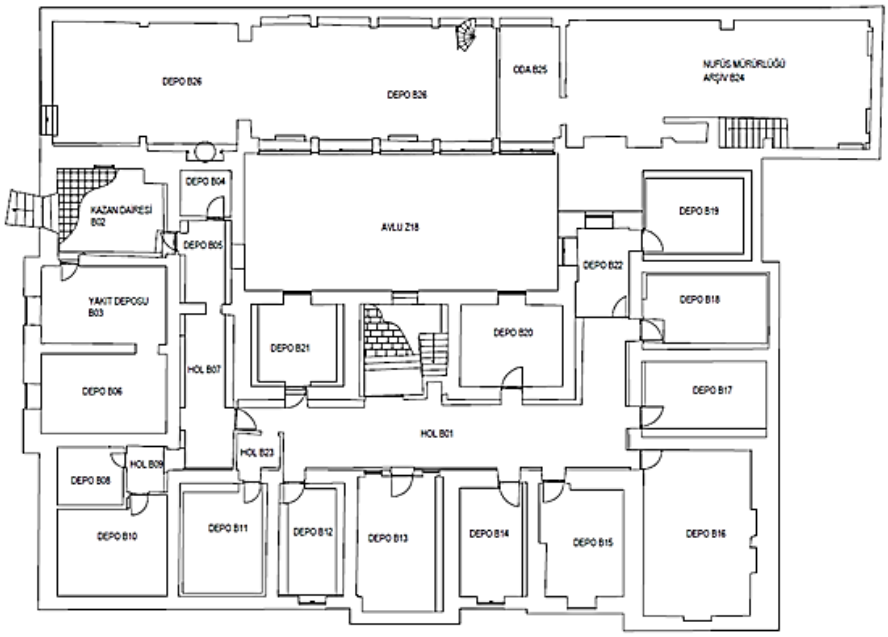


Figure 3. Basement floor plan analytical survey drawing

Architectural features of the ground floor

The southern section of the ground floor is dedicated to a group of spaces, including rooms Z20, Z21, Z22, Z23, Z24, and Z27. These areas belong to the population directorate. The rooms of the population directorate are arranged in an east-west direction, with interconnected passages between them. The connection between the population directorate and the main building is established through two door openings on the north wall of room Z24, leading to room Z02 (Personnel Affairs) and the Z01 hall.

As seen in the photograph, the spaces in this area of the building are arranged around the Z01 Hall. The floor of the hall is covered with ceramic tiles, while the walls and ceiling are plastered. To the east of the hall, rooms Z02, Z03, Z04, and Z05 are located, while rooms Z13, Z12, Z11, and Z10 are situated to the west. On the north side of the hall, rooms Z05, Z06, Z07, Z26, Z08, Z09 can be found, while rooms Z14 and Z15 are positioned on the south side. the north side of the z01 hall houses various units, including application units z05, interview room z06, application and identification unit z07, windbreak, z26, room z08, room z09, and room z10. the floor, walls, and ceiling of the hall are adorned with ceramic tiles and plaster.

Moving westward from the Z01 Hall, one can find district governor's archive- Z13, prayer room- z12, and room-Z11. The floor, walls, and ceiling of this area of the hall are also finished with ceramic tiles and plaster. On the south wall of the hall, there is a tea room with rooms Z15 and Z14. Additionally, there are reinforced concrete stairs in the central axis of the hall, providing access to the upper and lower floors (Figure 4).

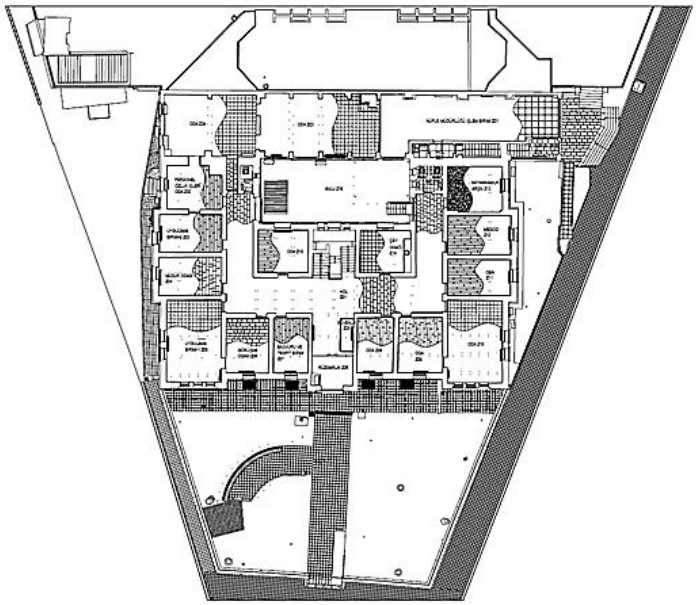


Figure 4. Ground floor analytical survey drawing

Architectural features of the first floor

The first floor plan of the building is almost symmetrical to the ground floor plan. On the first floor, there are rooms belonging to the southern section of the building, including room -126, photocopy room -124, archive room- 125, population registry archive- 123, population registry transaction counters -122, and population registry director's office- 121. These rooms, like on the ground and basement floors, belong to the population registry department. The rooms belonging to the Population Registry Department are arranged in an east-west direction, and the transitions between spaces are facilitated through connecting rooms.

Room 126 and photocopy room 124 have openings on their northern walls, providing access to the main building (accounting office -102 and storage room- 116). The connection between the ground floor and the first floor is established through concrete stairs, with the creation of the central space, room -120, towards the south. The rooms belonging to the Population Registry Department are arranged from east to west in the floor plan. No significant deterioration is observed in these rooms. The walls are plastered, the ceilings are suspended ceilings or plastered, and the floors are either ceramic or parquet.

The main space of the building follows the 'U' scheme and consists of rooms placed around the courtyard and room-101. On the south wall of the central space, there are room -115, the furnishing room, and room 114. on the south wall of hol -120, there are room -107 (secretary's office), room -108 (governor's office), and room -109 (governor's resting room) (Figure 5).

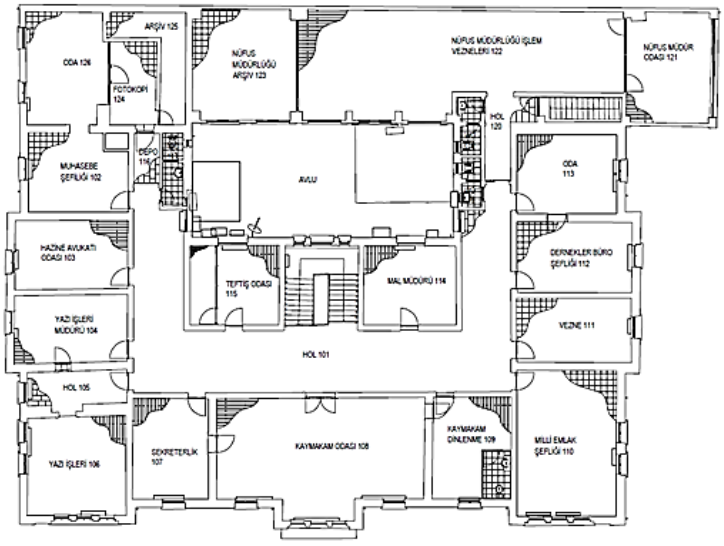


Figure 5. First floor plan analytical survey drawing

Conclusion

The study focuses on the documentation of material deterioration in historical buildings by combining data obtained through terrestrial laser scanning with on-site observations. It aims to analyze the current state and architectural features of the historical structure based on research conducted with terrestrial laser scanning techniques. The evaluation involves integrating the data obtained from laser scanning with other collected data to document material deterioration in the building. The study is significant in its systematic approach of showcasing the methods for creating orthophotos as a basis for documentation by converting the data obtained from laser scanning into visual representations. It emphasizes the importance of documenting the architectural features and current condition of historical buildings.

Based on the findings, the historical Karacabey Government Mansion exhibits various types of material deterioration, including surface pollution, incorrect repairs resulting from human activities, and the detachment of plaster due to faulty restoration work. The observed damages in the structure can be attributed to user-related deterioration and the adverse effects of environmental conditions.

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UAV-based construction progress monitoring: enhancing efficiency and safety

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Cite this study: Polat, N. (2023). UAV-based construction progress monitoring: enhancing efficiency and safety. Advanced Engineering Days, 7, 60-62

Keywords
UAV
Photogrammetry
Orthophoto
Monitoring
Construction

Abstract

Unmanned Aerial Vehicles (UAVs) have gained significant attention for monitoring construction progress, offering real-time and accurate information for site management. This paper explores the advantages of utilizing UAVs in construction progress monitoring and highlights their contributions to decision-making, project coordination, data accuracy, and site safety. UAVs provide a comprehensive aerial view of the construction site, facilitating a better understanding of progress and spatial relationships. Regular monitoring at predetermined intervals enables time-lapse records, aiding in identifying changes and delays. Furthermore, UAVs enhance data accuracy through advanced processing techniques, enabling precise measurements and objective assessment of progress. They also improve safety by accessing hazardous areas and assisting in safety inspections. The study focuses on monitoring a new dormitory building at Harran University Osmanbey Campus using UAV flights at different times, providing insightful analyses for construction management. These findings contribute to the construction management field, benefiting project stakeholders and expanding our understanding of effective monitoring techniques. With advancing technology and evolving regulations, UAVs are expected to play an increasingly prevalent role in construction progress monitoring, enhancing project management practices.

Introduction

Monitoring construction progress using Unmanned Aerial Vehicles (UAVs) has gained substantial attention in recent years due to its potential to provide real-time and accurate information for construction site management. UAVs, equipped with cameras or sensors, have the capability to capture high-resolution images, videos, and data of construction sites from various angles and heights, thereby enabling detailed monitoring of construction progress [1].

The utilization of UAVs in construction progress monitoring offers several advantages over traditional manual methods [2]. Firstly, UAVs provide a comprehensive and holistic view of the construction site, allowing project managers and stakeholders to observe the entire project area simultaneously. This aerial perspective provides a better understanding of the overall progress and spatial relationships between different elements of the construction site, thereby enhancing decision-making and project coordination. Secondly, UAVs facilitate regular and consistent monitoring of construction progress by capturing data at frequent intervals. This temporal analysis facilitates the identification of changes, delays, or deviations from the planned schedule. Moreover, the use of UAVs in construction progress monitoring enhances data accuracy and reduces human error. The captured images and data can be processed using advanced photogrammetry and computer vision techniques, resulting in the generation of accurate three-dimensional (3D) models, point clouds, or orthomosaic maps of the construction site [3]. These digital representations provide precise quantitative measurements, such as volume calculations and area analysis. They enable effective comparison with as-planned models, facilitating objective assessment of construction progress and supporting quality control. UAV-based construction progress monitoring also contributes to improved safety on construction sites [4]. Rather than manually inspecting hazardous areas or relying on personnel to climb structures for visual inspections, UAVs can access hard-to-reach or dangerous

locations, minimizing risks to personnel. The captured data can be used for safety inspections, identifying potential hazards, and ensuring compliance with safety regulations, thus enhancing overall site safety.

In the context of this study, the objective was to monitor the progress of the new dormitory building at Harran University Osmanbey Campus. This was accomplished through the implementation of UAV flights conducted at three different date, allowing for a comprehensive assessment and analysis of the construction progress. By employing UAVs as a monitoring tool, the researchers were able to closely observe the various stages of the construction process and present insightful analyses. The findings from this study contribute to the existing body of knowledge in effective construction site monitoring techniques.

Material and Method

UAV-based photogrammetry utilizes small onboard cameras to capture high-resolution imagery, enabling the generation of accurate 3D models, point clouds and orthophoto [5]. The process involves capturing multiple images from different perspectives and utilizing image processing techniques to extract spatial information. One commonly used technique in UAV-based photogrammetry is Structure from Motion (SFM), which leverages image overlap and feature matching to create photogrammetric products. SFM algorithms estimate camera positions, orientations, and calibration parameters, allowing for the reconstruction of the scene in three dimensions.

The process begins with an UAV flight conducted over the targeted area, capturing a series of overlapping aerial images using a digital camera. These images are then subjected to processing using the SfM technique, which is a computer vision method enabling the reconstruction of 3D information from a sequence of two-dimensional (2D) images [6]. The SfM algorithm analyzes common points or features present in multiple images and utilizes intrinsic and extrinsic camera parameters, such as focal length, distortion, principal point, camera position, and orientation, to compute the 3D coordinates of the points in the scene, resulting in the creation of a point cloud representing the scene's structure. SfM algorithms are rooted in the principles of photogrammetry, computer vision, and machine learning, representing state-of-the-art techniques widely accepted in the field [7-8]. As technology continues to advance, UAV-based photogrammetry is expected to play an increasingly significant role in the construction industry. Its ability to provide accurate and timely information for decision-making, along with its cost-effectiveness and versatility, make it a valuable tool for enhancing efficiency and productivity in construction projects.

Results

Both orthophoto and DEM were produced by flying the study area by UAV at three different times. For this purpose, the DJI Mavic 2 Pro, a UAV system was used to fly from a height of 50 m. The first flight was made on empty land. That is, it was carried out in the natural state before any work was done. The second flight was realized after the building foundations were completed and the construction progressed for a while. In this case, elements such as materials brought to the construction site, building columns, excavated foundations, construction equipment and soil heaps can be easily seen. The third and final flight was carried out at a time when the floors of the building were rising and its shape was well revealed. It is possible to say that there is more than one building and the construction will continue for a while.

Changes in the field such as excavated foundations, piles of earth and building constructions can be observed very easily from orthophoto. Additionally, the changes in the height of the land (rise of buildings) and volume calculations can be made easily by using DEM. At this point, it should me mentioned that, the digital photogrammetric products obtained through UAV-based monitoring offer versatile applications beyond safety and progress observation in construction sites. These products can be utilized for various engineering requirements, such as cross-section production, 3D model slope and aspect maps, and other essential analyses. The digital environment enables efficient extraction of valuable engineering information, contributing to enhanced decision-making and meeting diverse project needs. The integration of UAVs and photogrammetry provides a powerful toolset for comprehensive construction site management and supports effective engineering applications. The generated orthophoto and DEMs are given in the Figure 1.

Conclusion

In conclusion, UAVs for monitoring construction progress offers numerous advantages in the field of construction site management. The ability of UAVs to capture high-resolution images, videos, and data from various angles and heights provides real-time and accurate information for decision-making and project coordination. Through the implementation of UAV flights at three different times during the construction of the new dormitory building at Harran University Osmanbey Campus, this study successfully demonstrated the effectiveness of UAV-based monitoring. The comprehensive assessment and analysis of construction progress allowed for a closer observation of the various stages of the construction process, providing valuable insights for project managers. The generated orthophoto and DEMs proved to be valuable tools for monitoring changes in the construction site. The orthophotos provided a clear visual representation of excavated foundations, soil heaps, and

building constructions, enabling easy identification of progress and deviations from the planned schedule. Meanwhile, the DEMs facilitated the analysis of height changes in the land and enabled volume calculations, contributing to efficient project management practices. Moreover, the integration of UAVs in construction progress monitoring enhances safety measures by reducing risks associated with manual inspections of hazardous areas.

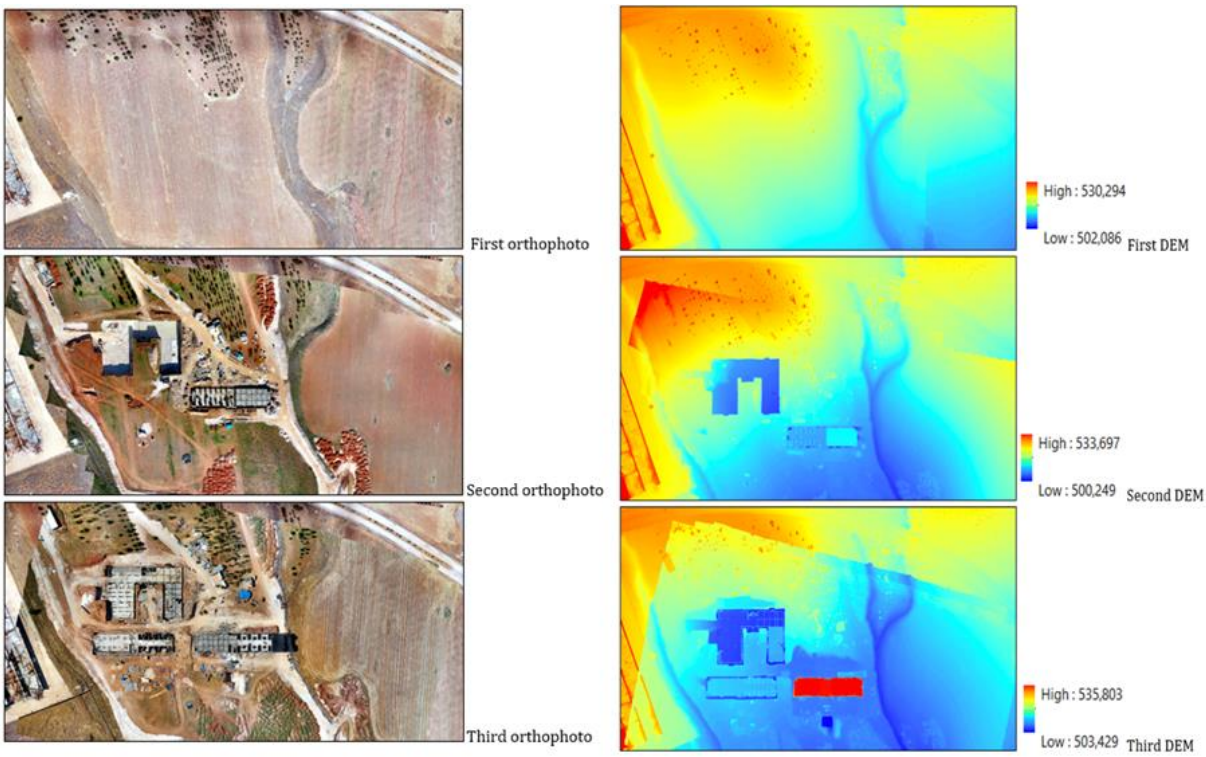

Figure 1. The produced orthophoto and DEMs

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Quality enhancement in digital twin production of complex architectures with integrated use of terrestrial and aerial images

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Cite this study: Sefercik, U. G., Aydın, I., & Nazar, M. (2023). Quality enhancement in digital twin production of complex architectures with integrated use of terrestrial and aerial images. Advanced Engineering Days, 7, 63-65

Keywords
Digital Twin
Unmanned Aerial Vehicle
Terrestrial
Photogrammetry
Data Fusion

Abstract

The concept of digital twin is included in many working disciplines today and its popularity is constantly increasing. There are photogrammetry-based mathematical models belonging to the geomatics discipline in the production of digital twin and three-dimensional (3D) model production can be easily realized with current advanced remote sensing technologies like unmanned aerial vehicles (UAV). However, when architectural components such as porches and eaves are taken into account, the inadequacy of altitude-based perspective creates serious problems in digital model production. In the solution of these problems, the need for terrestrial imaging arises and quality enhancement can be provided by data fusion. In this study, it is aimed to produce a high-quality digital twin of the Gebze Technical University Geomatics Engineering Department building. This building stands out with its different architectural structures due to its densely patterned exterior and reflective surfaces. Terrestrial and aerial photogrammetry were used in an integrated way with the aim of producing the highest quality of all facades of this building, which has a very difficult structure for the production of digital twins. Visual and statistical analyzes of the final outputs were carried out and the problems encountered in integrated methods due to complex architectural structures and alternative solution methods were discussed.

Introduction

In recent years, there has been an evolution towards the digital era in the production and protection of objects [1]. With the changing technological equipment and user demands, the concept of digital twin has emerged in order to use the models of objects effectively [2]. Until today, this concept has had many definitions such as digital double, digital master and digital shadows [3-5]. Finally, the concept of digital twin has been accepted as the closest copying of physical objects to the real thing and displaying the relations of these objects with each other in the virtual environment [6].

Digital twin production is gaining importance day by day and finds its place in many fields of work [7]. To obtain maximum quality in digital twin production, all facades of the object must be displayed in detail at the appropriate illumination condition and overlap rate. With the integrated use of different methods, it becomes possible to cover all surfaces of the structure subject to the model [8].

In this study, it was aimed to increase the quality of digital twin production in complex structures and data fusion processes were carried out in this direction. Terrestrial photogrammetry was employed to capture a comprehensive view of the under-awning areas, which proved challenging for the UAV's limited viewing geometry. In addition, by being integrated oblique flight data, this technique enabled the acquisition of precise data pertaining to the roof surfaces of the building, where traditional terrestrial photogrammetry alone fell short. As a result, the targeted fusion study was carried out successfully, and the geometric accuracy and spectral analysis results were examined in detail.

Study Area and Materials

The study area is located on the campus of Gebze Technical University, within the borders of Kocaeli, Türkiye. Unlike many buildings on the campus, the Geomatics Engineering building, which stands out with its different architectural plan, was chosen for 3D model production. This building, which was built on an area of approximately 1500 m^2, consists of intense reflective surfaces as all its facades are covered with glass. DJI Phantom IV Pro V2.0 UAV was used for oblique imaging and NIKON D3500 digital single-lens reflex (DSLR) camera was used for terrestrial imaging to obtain images of the exterior surface of the building. Nikon camera has a 24-megapixel sensor while DJI Phantom Pro IV V2.0 UAV has a 20-megapixel CMOS (Complementary Metal Oxide Semiconductor) sensor. In addition to these devices, CHC i80 Global Navigation Satellite System (GNSS) receiver and Geomax Zoom25 total station were used to determine the coordinates of ground control points (GCPs) and checkerboards, respectively (Figure 1).

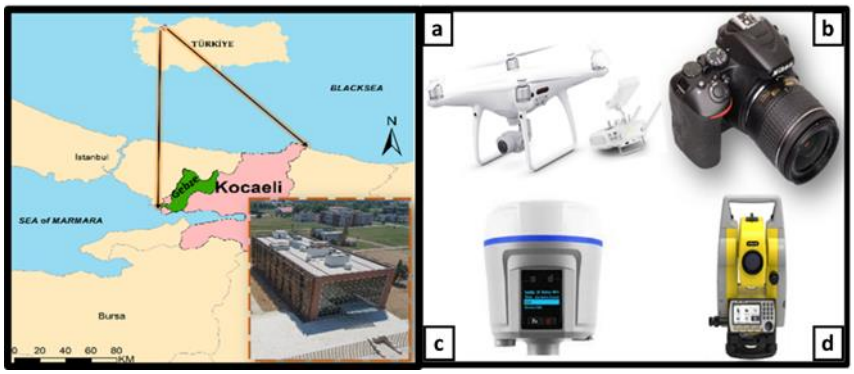

Figure 1. Study area, GTU geomatics engineering building, and used devices: (a) DJI Phantom Pro IV V2.0, (b) Nikon D3500, (c) CHC i80 GNSS and (d) Geomax Zoom25, respectively.

Methodology

The study consists of six steps: field reconnaissance, data acquisition, image enhancement, digital twin generation and statistical and visual analysis of the final products, respectively. Within the scope of the study, the field reconnaissance of the building was carried out. For the oblique flight performed with the UAV, it was taken into account that all images contain GCPs. In line with this goal, a total of 18 GCPs were installed, 12 on the land surface and 6 on the roof of the building. In addition to these, 20 checkerboards are positioned on the four facades of the building for terrestrial imagery. After the coordinate measurements of all control points were completed, image acquisition was performed. The NIKON D3500 DSLR camera was used with an 18 mm fixed focal length and fixed base interval for the capture of terrestrial images. The location of the image capture points is determined in computer-aided design (CAD) environment depending on the 22 m base distance and focal length where the entire front will be located in a single photo frame. The base distance between the two photographs was determined by taking into account the overlay rate (Figure 2). In the same way, image acquisition was performed by maintaining the overlap rate in oblique flight, but spectral mismatch occurred in terrestrial and aerial image acquisition due to different perspectives. This problem has been solved by applying the same filter to all images with the color editing facility provided by Adobe Photoshop Lightroom software.

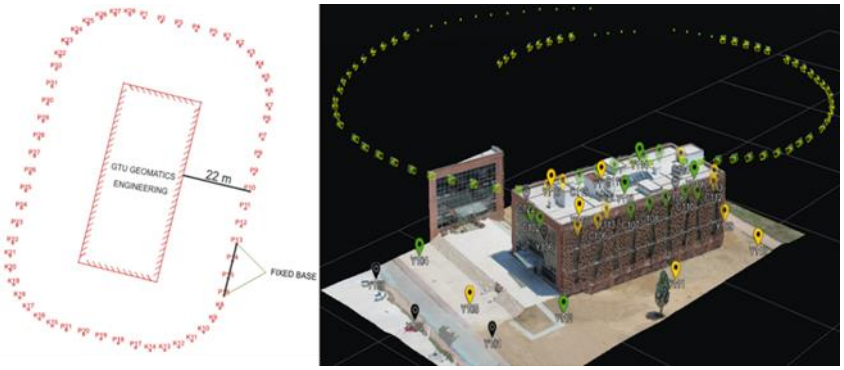

Figure 2. (a) Terrestrial and (b) Aerial photograph shooting points

ContexCapture software was used for the processing, fusion, and 3D building model production of all images with the help of photogrammetric methods. Ensuring that both aerial oblique imagery and terrestrial imagery for

3D modeling have accurate georeferencing or, at the least, a distinct spatial reference is a crucial step of integrating their processing (1). All data sources were evaluated simultaneously during the processing of the images, with the aim of producing dense point clouds obtained from both sources with common relative accuracy. As a result of the defined workflow, the root mean square error (RMS) for exterior orientation was calculated as 1.7 cm.

Results

3D modeling work was carried out with the terrestrial and airborne datasets acquisition for the building and the final outputs were given in Figure 3. After the fusion of data from different sources, the shadow effect due to the perspective has clearly emerged (Figure 3a). On the other hand, building roof surface modeling, which is often mentioned in the literature as a weakness of terrestrial photogrammetry, was also encountered in this study. It has been observed that the canopy located above the building entrance cause to distortions in the images taken with a perpendicular view to the façade (Figure 3c). The imaging problem experienced by the UAV in the areas under the canopy of the building caused insufficient point density in the point cloud and created interpolation errors (Figure 3d). Spectral mismatch caused by the shadow effect has been resolved by image enhancement methods (Figure 3b). Interpolation errors caused by a lack of data are eliminated by the fusion of images obtained from different sources with high geometric accuracy. The resulting products demonstrated the success of the proposed fusion method and ensured the realization of the goal of increasing quality in digital twin production.

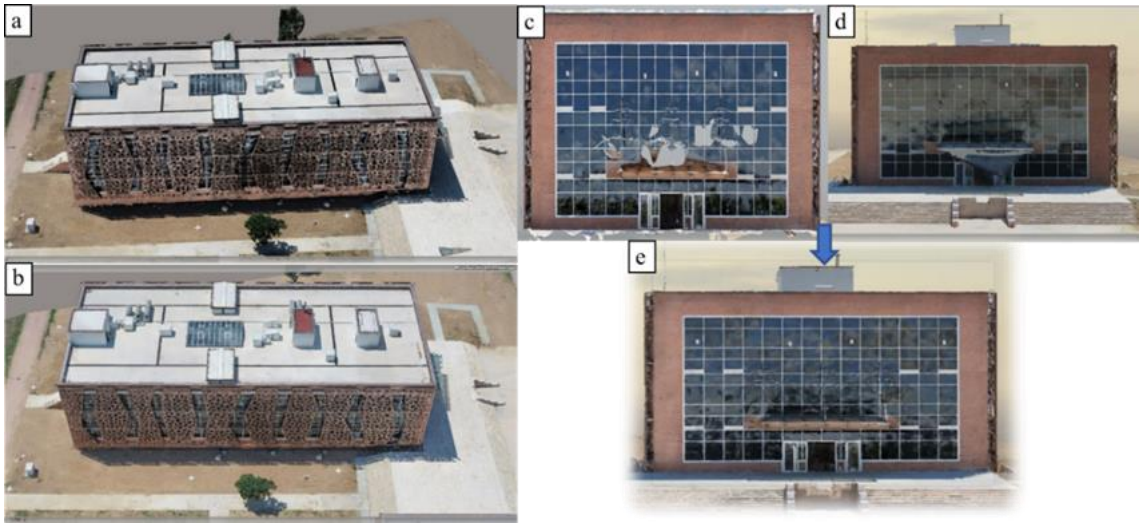

Figure 3. 3D building models (a) before image enhancement (b) after image enhancement, Modeling results (c) with terrestrial data and (d) with aerial data

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Reducing noise pollution using panels: The case of Konya City

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Cite this study: Ertekin, S., & Dursun, Ş. (Year). Reducing noise pollution using panels: The case of Konya City. Advanced Engineering Days, 7, 66-68

Keywords
Noise pollution
Traffic noise
Noise control panels
Solid waste

Abstract

Complaints about noise caused by the increasing vehicle load in big cities are increasing. City center transmission density, wide roads, road location and road surface coverage, traffic signaling systems in the city are the factors that monitor environmental pollution. Non-compliance with the rules in traffic, especially the stop-stops of small public transportation vehicles, wrong parking, heavy use of motorcycles and other transportation vehicles cause noise in the traffic density. Insufficient increase of road surface in the city. To minimize the negative effects of evaluations on people, the use of environmental panels on urban and extra-urban highways is one of the solutions. In this study, the use of environmental panels to prevent traffic congestion in Konya province and the usability of end-of-life tires (ÖTL) as the basic material of the panels were investigated. In this way, it has been investigated that the tire hose that has completed its life is not thrown away and the possibility is evaluated. Arrangements made within the scope of zero waste of the study will be supported. His designated area for evaluation of behavior is measuring data before and after panel installations. In the study, the boundaries of which points can be placed have been studied. With the obtained data, the environmental simulation application of Konya was modelled with SURFER software and reflected on the map. In this way, a clearer differentiation of the normal distribution of the environment in the city and the predicted diffraction after the panel was achieved

Introduction

Noise is a collection of sudden or continuous complex sounds in acoustically arbitrary waveforms and with multiple unrelated frequency components, also with high pressure and time varying pressure. It is necessary not to be exposed to noise because of the negative effects of noise such as adversely affecting the hearing performance and perception of people in terms of health, disrupting the physical and psychological balance, reducing the work performance, disturbing the peace and tranquility of the environment, and thus changing the quality of the environment. Also, measures should be taken to deal with noise. Therefore, noise measurements are very important. Dalkılıç and Dursun [1] have shown in their studies that the noise level of municipal buses and minibuses, and even heavy vehicles entering the city center uncontrolled, increases up to 85-86 dBA. It has been determined that such vehicles cause a noise increase of 8 dBA, and three-wheeled engines 10 dBA.

Road traffic noise is of paramount importance in terms of overall environmental impact and the problem should be technically assessed and solutions or alternative ways considered through appropriate and consolidated procedures. So far, there is no regulated guide for determining well-founded priorities when dealing with the various road sections covered in the relevant Action Plans against noise within the scope of the Environmental Noise Directive [2]. In recent years, population movement between cities, unplanned development of cities, traffic congestion and excessive increase in motor vehicles cause environmental problems, especially noise pollution. The effect of the city plan implementation (ideal use in road and building areas, building-green area ratio) on noise pollution was investigated. Konya noise pollution map is presented with 366 sampling points selected on the main roads in the city centre of Konya. Modelling with Konya city noise pollution map is shown. A significant impact of increased building levels on noise levels was also found near major roads [3].

Material and Method

Study Area: To evaluate the noise caused by the highways of the city connection roads, to reveal the effects on the people living in the areas close to the road, and to exemplify the control measures, it was preferred to examine the houses living in this area with the following steps. The measurements were carried out on Adana Ring Road (Figure 1).

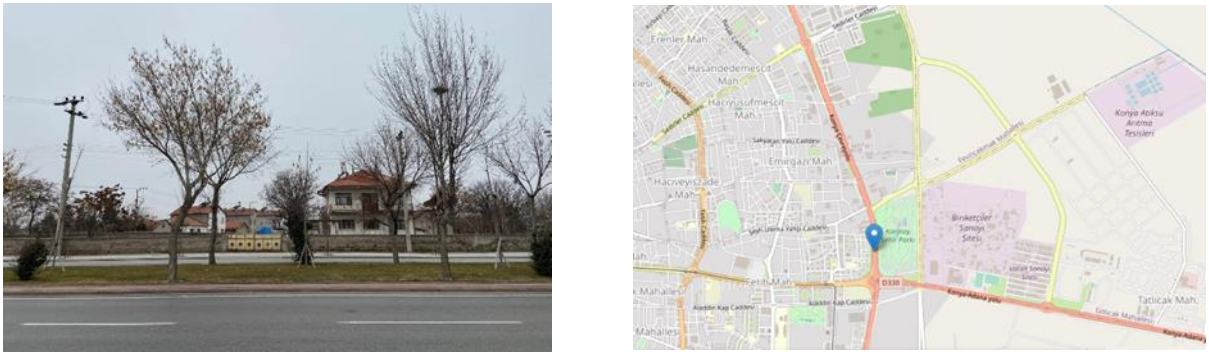

Figure 1. Measurement point and area map image on Adana Ring Road

Styrofoam Panel: EPS (Expanded Polystyrene) Styrofoam is a thermoplastic, closed steam, heat release material produced by inflating and combining polystyrene particles, and 98% of it consists of inert dry air. It provides high thermal insulation. The thermal conductivity group is 0.40. It is not fragile; Styrofoam is pressure resistant. There is no capillary water permeability. The thickness of the Styrofoam remains constant with pressure. It is an environmentally friendly material and Styrofoam does not harm the ozone layer. It provides an easy and economical system to implement. It is used today to prevent sound noise. For this reason, it was thought that it would be a suitable material for the panel.

End-of-Life Tire (ELT) panel: Tires are complex materials made from rubber and various other reinforcement materials. Thanks to its shock absorbing feature and flexibility, it prevents fragmentation that may occur because of falling and impact. Long lasting, easy to clean. Being weather resistant. It was preferred because it is a recyclable material, and it has a dry, clean and non-slip surface feature without puddles even after heavy rain (Figure 2).

Results

Highways have been developed to a great extent in Konya with connection roads; Konya is among the few provinces of Turkey in terms of the number and size of motor vehicles. In addition, in terms of transportation, Konya is located on the main traffic axes of Turkey. It has a significant traffic potential due to its capacity in agriculture and tourism. The houses living in this area are generally detached houses, while the number of households living in this area is around 2200, it is assumed that approximately 1000 households are affected by noise because they are close to the roadside. More detailed measurements were taken in certain areas over the areas where the people living in this area heard the soundest.

During the measurement time, the short-term sound pressure level should be recorded with a sampling time slightly lower than the time constant set for time weighting. The class intervals from which recorded results will be determined should be 1.0 dB or less, and the baseline on which the parameters are based and, where appropriate, the time weight (record time) and class interval used when assigning the LNT should be reported. In the residential area, noise level measurements were made outside the building within the scope of the study. The testo 815 noise level measuring device was used in the measurements and the measurements were started after the calibration of the device was completed.

The measurements were made in accordance with the TS 1996-1: 2020 standard, at 1 meter from the main road and at a height of 1.5 meters from the pavement; Outside the area where the building area is located, five-minute measurements were taken at 1.5 m from the ground and 2 m from the facade. Noise level measurements were made at 10 points without the panel during the car passing on the roadside and at 20 points in total, including 10 points on the back of the panel during the passing of the cars. Noise modelling was carried out to evaluate the noise panel from all aspects within the scope of the study. The order in which the maps are created is as follows: First, the coordinate data are saved in the Excel program. Then it was saved as Surfer data application and configured as grid data. The noise level is colored with the Contour maps tool (Figure 2-3).

Conclusion

Previously researched and 2.5. given under the heading; In September 2005, in the study conducted for the high-speed train in Turin-Novara region of Italy, the acoustic barrier installed along the high-speed railway line was tested and the 45/48 dB degree obtained in the laboratory increased to 37 dB in front of the concrete elements and 20/19 dB' behind the concrete elements. was found to have fallen. However, in the on-site application, these results could not be obtained, and the study was unsuccessful. As a result, the researcher determined that the lesson to be learned in the study is that the blocks are weakly attached to each other and to the poles, and that very large insulation panels are useless and unstable. It was concluded that all components of the acoustic barrier and their connections must be carefully designed [4].

In our study, the designed barrier structure achieved a dynamic potential and enabled us to obtain more consistent results in this context. According to the evaluations, it was determined that an area of 8 km^2 and approximately 2% of the total city population were affected by the noise level above 75 dB(A) in a 24-hour period. It has been calculated that the 37 km^2 area in the study area and approximately 14% of the total city population are affected by the noise level above 80 dB(A). As a result of the calculations, it has been determined that the 28.6 km^2 land around the highways and approximately 38% of the total city population are exposed to a noise level of 71 dB(A) and above. Noise is harmful to human health. It can cause hearing loss. Studies on the identification, calculation and modeling of noise sources have been explained in the previous chapters. It has been determined in scientific studies that the most common source of noise pollution is motor vehicles. Within the scope of the study, it has been determined that no exposure to noise due to the negative effects of noise such as adversely affecting the hearing performance and perception of people in terms of health, disrupting the physical and psychological balance, reducing the work performance, disrupting the tranquility and tranquility of the environment, and thus changing the quality of the environment. In addition, it has been determined that noise pollution continues to increase with the increase in industry and vehicle use due to the increasing population. Within the scope of the research, different noise panels were tried in industrial facilities and achieved successful results.

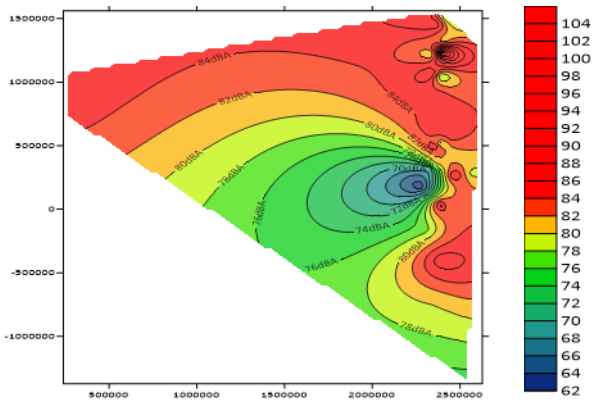

Figure 2. Noise map Measurements Taken During Daytime (Data taken when no panel)

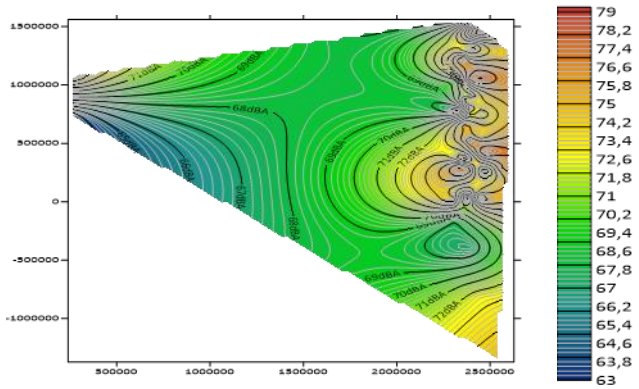

Figure 3. Noise map Measurements Taken During Daytime (Data taken when panel is present

Acknowledgement

This paper has been prepared a part of Sedanur Ertekin MSc. Thesis.

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Investigating the Yahyalı (Kayseri, Türkiye) Pb-Zn deposit by using IP/Resistivity methods

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Cite this study: Yalçın, C., & Canlı, H. (2023). Investigating the Yahyalı (Kayseri, Türkiye) Pb-Zn deposit by using IP/Resistivity methods. Advanced Engineering Days, 7, 69-72

Keywords
Geopyhsical
Pb-Zn
IP/Resistivity
Mining
Yahyalı

Abstract

There are significant Pb-Zn mineralizations along the Taurus Orogenic Belt. Various mining operations have operated in these regions from ancient times to the present day. Aladağ-Zamantı province is also one of these major areas. Substantial mining activities are ongoing in several locations in this province. Yahyalı Region is also an area located within this belt. Pb-Zn ore mineralization is observed in Devonian aged carbonates southeast of Yahyalı (Kayseri-Türkiye). Geophysical studies were carried out to determine the ore geometry and potential in this zone. In this region where IP/Resistivity methods were practiced, we have taken several measurements along specific profiles and have evaluated them in combination. As a result of the study, it was concluded that the areas with high chargeability characteristics are rich in sulfide minerals. As a complementary conclusion of the evaluation of both methods, it was realized that the data were in compliance. Therefore, using these geophysical methods in sulfide-rich areas has been deemed to be advantageous in terms of mining activities.

Introduction

Electrical resistivity tomography is widely used for characterizing subsurface structures and overlaying geological settings [1-2]. The induced polarization (IP) can even detect information of small conductive rocks that have been extinct in the subsurface. Resistivity models resulting from both resistivity and IP studies can also identify the presence of sulfur in minerals, mineral deposits and soils [3].

Geological structures where sulfide minerals occur show low resistivity and high chargeability [4-5]. High chargeability and high resistivity anomalies have also been attributed to the presence of disseminated sulfides [6]. Successful applications have been made with these geophysical methods used in mineral exploration. Resistivity and induced polarization applications in lead-zinc exploration have been applied in many studies by various authors [7].

Pb-Zn mining in Turkey extends back to the Roman period [8]. The most important mining sites are observed along the Taurus Orogenic Belt. The Aladağlar-Zamantı province of the Eastern Taurus Mountains has been attracted the interest of many researchers because it is the most prominent carbonated Zn-Pb producing region of Turkey [9-11]. The study area is located in this belt and covers the southeast of Yahyalı region.

In this study, geophysical studies were carried out for the ore potential of the Pb-Zn deposit in the southeast of Yahyalı (Kayseri-Türkiye). Through this study, important data belonging to the region were obtained and provided in the literature.

Material and Method

The IP/Resistivity method is based on the principle that some rocks act like a capacitor and retain some of the current for a certain period of time after the electric current is cut off. The distribution of metallic mineral particles

in rocks is the source of IP anomalies. Increasing the concentration of polarizable sulfide minerals increases the chargeability values. In other words, mineralization is directly related to chargeability values.

True chargeability; (M") is the ratio of the voltage after the current is cut off to the voltage measured during the current supply and is defined as mVolt/Volt. It varies between 0-1000 mv/v values.

In resistivity (electrical resistivity) method applications; electric current is sent into the ground through a stainless metal-steel electrode driven into the ground. With the help of two electrodes placed at two other points on the ground, the voltage difference in the ground is measured. The unit of the applied current is recorded in amperes (usually milliamperes) and the unit of the measured voltage in Volts (usually millivolts). Using the measured values and the geometric factor K (array factor) of the electrode array used, the apparent resistivity (in ohm-m) is calculated for this measurement location. The calculated value is assigned below the midpoint of the electrode array system.

In the study area, the AGI brand, 8-channel, 84-electrode resistivity and IP measurement device with 84 electrodes was used.

Dipole-Dipole Gradient method was applied and 19 profiles were made with 20-10-7 meters between the electrodes. This measurement was evaluated in EartImager 2D evaluation program. In this study, the data of 3 profiles are presented.

Mineralization

The study area is located in an area where the fractures and faults of the nap tectonics in the Eastern Taurus Mountains are very intensive. In this region, Aladag and Yahyalı nappes are observed together [8]. Both tectono-stratigraphic units have similar lithological features and host Pb-Zn mineralizations in different locations [8]. This region is also called the "Aladağ-Zamantı Zn-Pb Belt" and has an important place in the Zn-Pb mining of Türkiye. Mineralization is associated with the Devonian-aged carbonates in the Aladag Nappe. In the ore zone, which is in the form of veins and veinlets in E-W direction, smithsonite, anglezite, cerusite and other alteration minerals are observed near the surface. The main ore minerals are galenite and sphalerite respectively [12].

IP-Rezistivity Results

Resistivity and chargeability data were compiled and inverted to obtain a more realistic geologic representation. GPS elevation data of the profiles were used to correct the effects of topography in the inverse analysis. Chargeability and resistivity graphs were prepared for the inverse solutions of the profiles.

In the graphs, warm red-purple colors were used to represent high chargeability and resistivity values and cool colors such as green and blue were used to represent low values. In this study, the important targets are considered to be the areas showing high resistivity (karstic sinkholes).

Normal chargeability values were observed in most of the profiles measured in the field. Probable sulphide ores are thought to be the cause of the high chargeability values obtained.

1. In the 1st profile, high resistivity and high chargeability were observed at the electrode spacing of 20 meters. At the 4th electrode (65 meters) depth, partial correspondence of chargeability and resistivity values indicates the presence of a low grade ore body with small reserves (Figure 1).

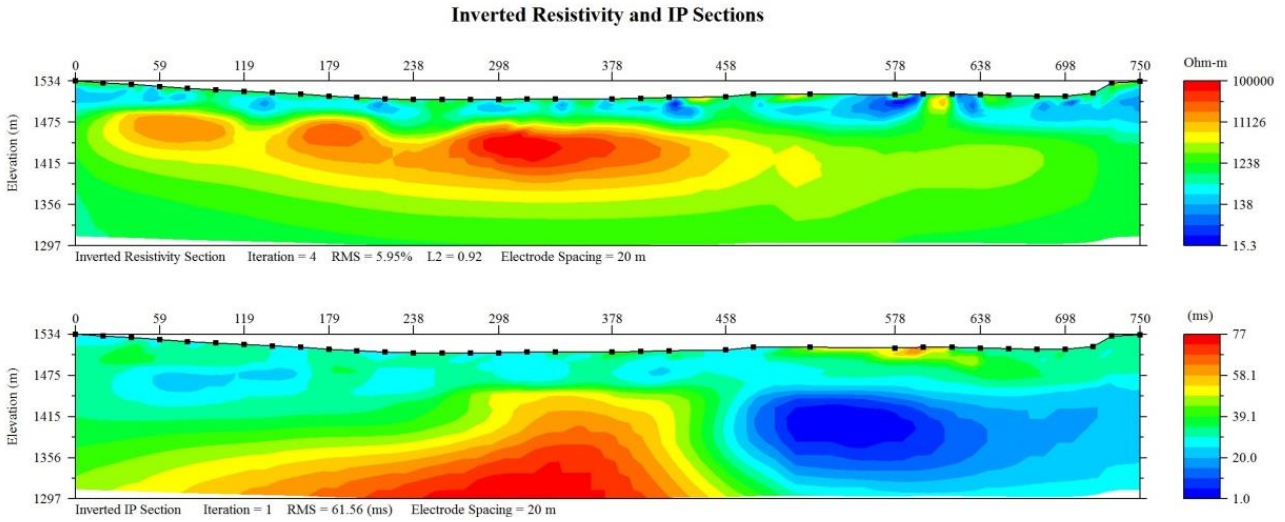

Figure 1. The inverted resistivity and IP sections of the 1st profile.

2. In the 2nd profile, high resistivity and high chargeability were observed at the electrode spacing of 20 meters. At the 4th electrode (65 meters) depth, partial correspondence of chargeability and resistivity values indicates the presence of a low grade ore body with small reserves (Figure 2).

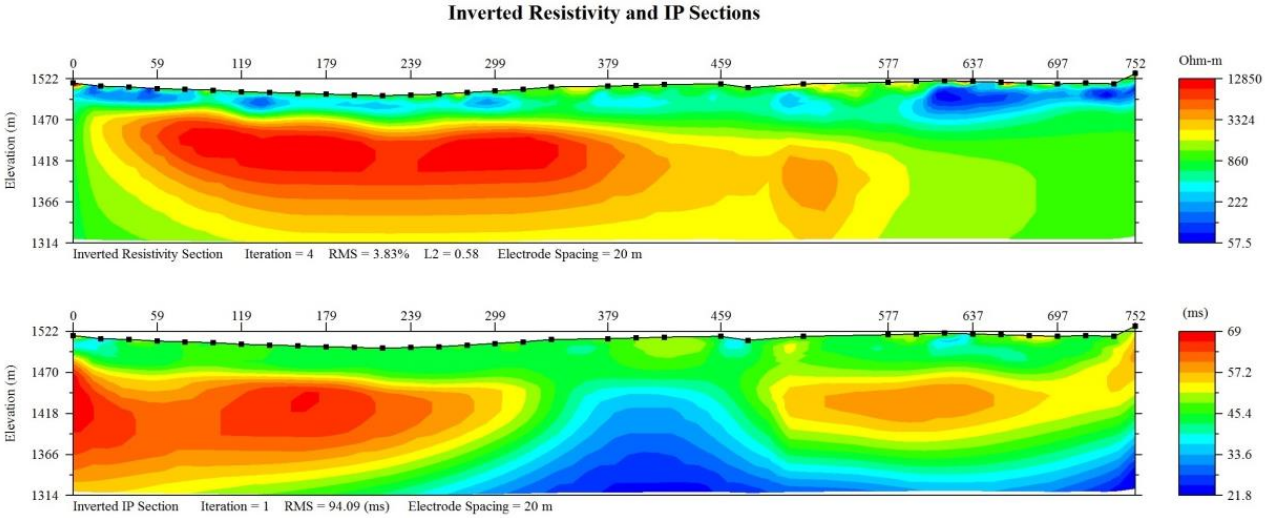

Figure 2. The inverted resistivity and IP sections of the 2nd profile.

3. An anomaly was observed at 336 meters of the profile with an electrode spacing of 10 meters and a depth of 32 meters (Figure 3).

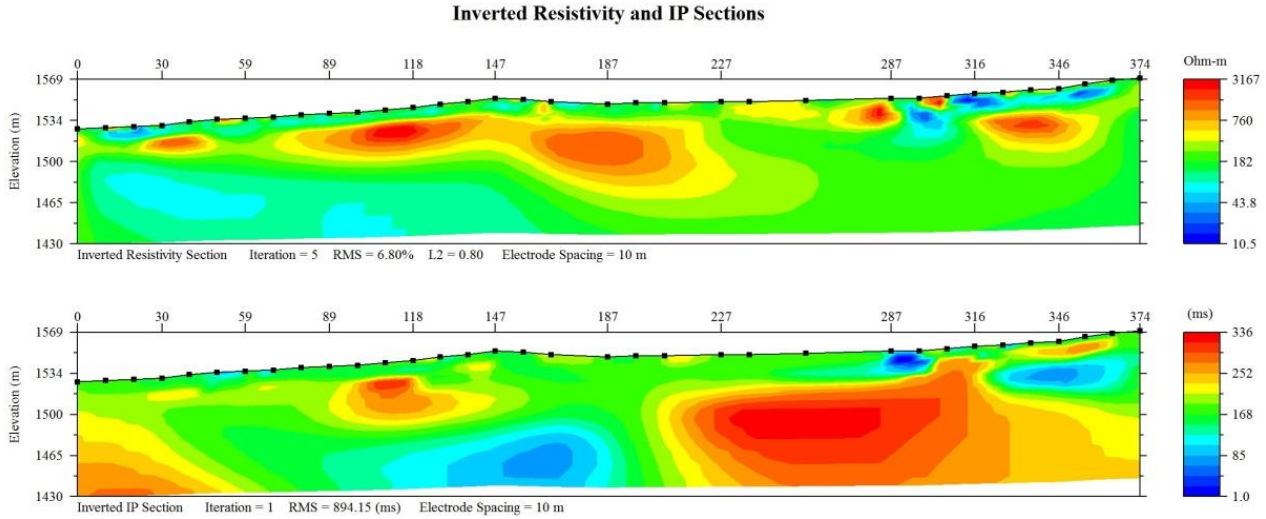

Figure 3. The inverted resistivity and IP sections of the 3rd profile.

Discussion

The induced polarization method improves electrical methods by measuring the chargeability of the soil material [13]. Chargeability provides an opportunity to assess the capacity of soil to store and then restore a current when currents are injected and then interrupted [14-17].

The resistivity tomography examines the horizontal and vertical distributions of the electrical properties of the soil. It quantifies the resistivity of the ground by passing an electric current through the soil through a pair of electrodes and by measuring the resultant potentials via a further pair of electrodes, called potential electrodes [18].

Both methods mentioned above have been implemented in the field. In previous studies, exploration drillings were carried out in two different areas where mineralization was considered and ore was cut in places. When these data were evaluated with the study, the following items were revealed.

1. It was observed that the potential mineralization in the study area is located northeast of the present drilling area.

2. In the study area, it was determined that young sedimentary units and altered sedimentary rocks have lower densities compared to their surroundings.
3. It is concluded that more priority should be given to the areas with Paleozoic-aged carbonate rocks in the study area.
4. Areas with high chargeability characteristics have been identified as potential areas.

Conclusion

There is already an operational mine southeast of Yahyalı where significant Pb-Zn mineralization is observed. Field studies have already been supported by drilling. However, geophysical studies, which provide information about the underground potential and geometry of the ore, contain important clues for the operation. It is understood that IP/Resistivity method can be used successfully in Pb-Zn fields which are sulfide mineralizations.

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Investigating the Kavşut (Göksun-Kahramanmaraş) Cu-Pb-Zn deposit by using IP/Resistivity methods

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Cite this study: Yalçın, C., Canlı, H., Haznedaroğlu, K., & Akbulut, F. (2023). Investigating the Kavşut (Göksun-Kahramanmaraş) Cu-Pb-Zn deposit by using IP/Resistivity methods. Advanced Engineering Days, 7, 73-76

Keywords
Polymetallic
Cu-Pb-Zn
IP/Resistivity
Mining
Kavşut

Abstract

According to its tectonic structure, Türkiye has major orogenic belts. Important ore deposits are observed along the characteristic Tethys metallogenic belt. Cu-Zn-Pb (polymetallic) mineralizations are hosted in many areas along this tectonic belt. The polymetallic enrichment southeast of Kavşut (Göksun, Kahramanmaraş-Turkey) is also located in the Tethys metallogenic belt. The region is basement to the Goksun ophiolites. This complex is overlain by the Malatya Metamorphites with a tectonic contact. Within these units, mineralization is observed in the fracture-cracks and karstic gaps of carbonate rocks. IP/Resistivity studies were carried out to reveal the geometry and distribution of this mineralization underground. It was determined that sulphide mineralizations show high rechargeability character. Cross sections and two-dimensional level maps were prepared according to the electrical data obtained for planning and coordination. This visual information provides very important information for the mining operation in the region.

Introduction

Electrical methods, which started in the 1920s and have developed greatly in recent years, have shown to be a powerful asset in the exploration of metallic and non-metallic mineral deposits [1-2].

Electrical resistivity tomography is widely used for characterizing subsurface structures and overlaying geological settings [3-4]. The induced polarization (IP) can even detect information of small conductive rocks that have been extinct in the subsurface. Resistivity models resulting from both resistivity and IP studies can also identify the presence of sulfur in minerals, mineral deposits and soils [5].

For the exploration of sulfide mineral deposits (e.g., Cu-Pb-Zn), combined geophysical surveys such as electrical and electromagnetic surveys have been practiced [6-7]. Both Electrical resistivity and Induced Polarization (IP) are two significant geophysical techniques used to map the location of sulfide minerals [8-9].

Geological structures where sulfide minerals occur show low resistivity and high chargeability [10-11]. High chargeability and high resistivity anomalies have also been attributed to the presence of disseminated sulfides [12]. Successful applications have been made with these geophysical methods used in mineral exploration. Resistivity and induced polarization applications in Cu-Pb-Zn exploration have been applied in many studies by various authors [13-14].

The Tethyan Eurasian Metallogenic Belt [15], which extends from Western Europe to Anatolia and Iran, is one of the most important metal formation belts [16]. Göksun (Kahramanmaraş) region is also located in this belt and hosts important metallic deposits.

In this study, geophysical studies were carried out for the ore potential of the Cu-Pb-Zn deposit in the southeast of Kavşut (Göksun, Kahramanmaraş-Türkiye). This study is a regional scale and recommendation and includes the determination of whether the relevant area is suitable for polymetal (Cu-Pb-Zn) mineral formation and

exploration, and if so, the determination of target areas for exploration and the selection of appropriate exploration methods. The literature was supported by observational geological data and then geophysical methods were applied.

Material and Method

The IP/Resistivity method is based on the principle that some rocks act like a capacitor and retain some of the current for a certain period of time after the electric current is cut off. The distribution of metallic mineral particles in rocks is the source of IP anomalies. Increasing the concentration of polarizable sulfide minerals increases the chargeability values. In other words, mineralization is directly related to chargeability values.

True chargeability; (M") is the ratio of the voltage after the current is cut off to the voltage measured during the current supply and is defined as mVolt/Volt. It varies between 0-1000 mv/v values.

In resistivity (electrical resistivity) method applications; electric current is sent into the ground through a stainless metal-steel electrode driven into the ground. With the help of two electrodes placed at two other points on the ground, the voltage difference in the ground is measured. The unit of the applied current is recorded in amperes (usually milliamperes) and the unit of the measured voltage in Volts (usually millivolts). Using the measured values and the geometric factor K (array factor) of the electrode array used, the apparent resistivity (in ohm-m) is calculated for this measurement location. The calculated value is assigned below the midpoint of the electrode array system.

In the study area, the AGI brand, 8-channel, 84-electrode resistivity and IP measurement device with 84 electrodes was used.

Dipole-Dipole Gradient method was applied and 24 profiles were made with 20-10-7 meters between the electrodes. This measurement was evaluated in EarthImager 2D evaluation program. In this study, the data of 3 profiles are presented. After the geophysical measurements, two-dimensional level maps were prepared to make the structure of the region more understandable.

Geology and Mineralization

The study area is located in the western part of the Eastern Taurus Mountains within the Taurus orogenic belt. In this region, allochthonous and autochthonous rock units represented by different ages and rocks are bound by tectonic contacts. Göksun ophiolitic rocks are observed at the base of the region and Malatya metamorphites are overlying it with tectonic contact [17-18]. These two units are cut by Esence granitoids [17]. Tertiary aged sediments cover all units with angular discordance.

Various anomalies were obtained in geochemical studies conducted in and around this region [19]. Tüfekçi and Dumanlılar [20] reported mineralization in alteration zones and karstic gaps. Ore paragenesis consists of chalcopyrite, sphalerite, galenite, pyrite, malachite and azurite respectively.

IP-Rezistivity Results

Resistivity and chargeability data were compiled and inverted to obtain a more realistic geologic representation. GPS elevation data of the profiles were used to correct the effects of topography in the inverse analysis. Chargeability and resistivity graphs were prepared for the inverse solutions of the profiles.

In the graphs, warm red-purple colors were used to represent high chargeability and resistivity values and cool colors such as green and blue were used to represent low values. In this study, the important targets are considered to be the areas showing high resistivity (karstic sinkholes).

Normal chargeability values were observed in most of the profiles measured in the field. Probable sulphide ores are thought to be the cause of the high chargeability values obtained.

1. Along the 1st profile, high resistivity inclusions are observed at 60 meters, 160 meters, 240 meters, 320 meters and 580 meters. High chargeability inclusions are observed at 60 meters, 280 meters, 380 meters, and 460 meters (Figure 1).
2. Along the 2nd profile, high resistivity inclusions are found to be more widespread at 160 meters and 220 meters. The main reason for this is the development of karstic gaps and fracture-crack system below this profile. In contrast, the chargeability is not as widespread as the high resistivity but in a narrower area at 270, 370 and 480 meters (Figure 2).

Two-dimensional level maps of different elevation values were prepared by evaluating the other profiles and the above profiles together. Of these maps, Figure 3 represents the 50-61 meter range.

Geophysical methods have an important role in mineral exploration. The preparation of visual cross-sections and maps for planning and coordination will provide a significant advantage.

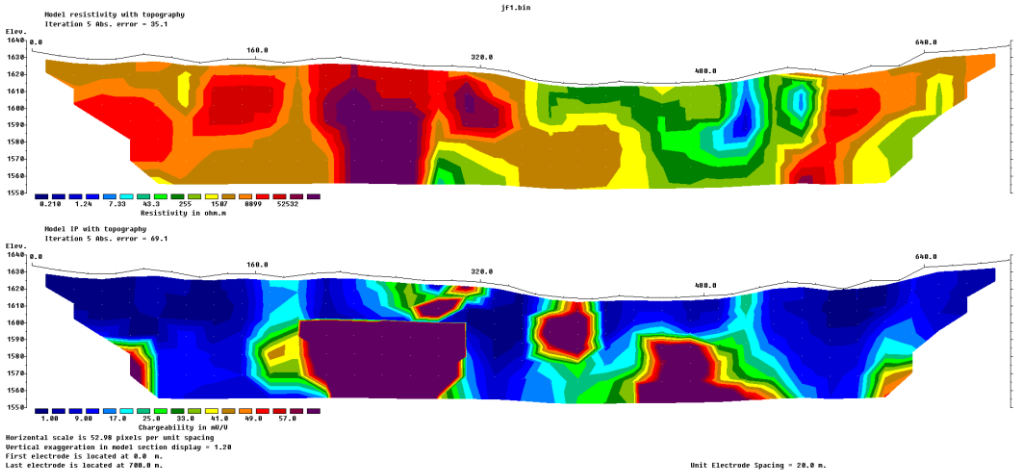

Figure 1. The inverted resistivity and IP sections of the 1st profile

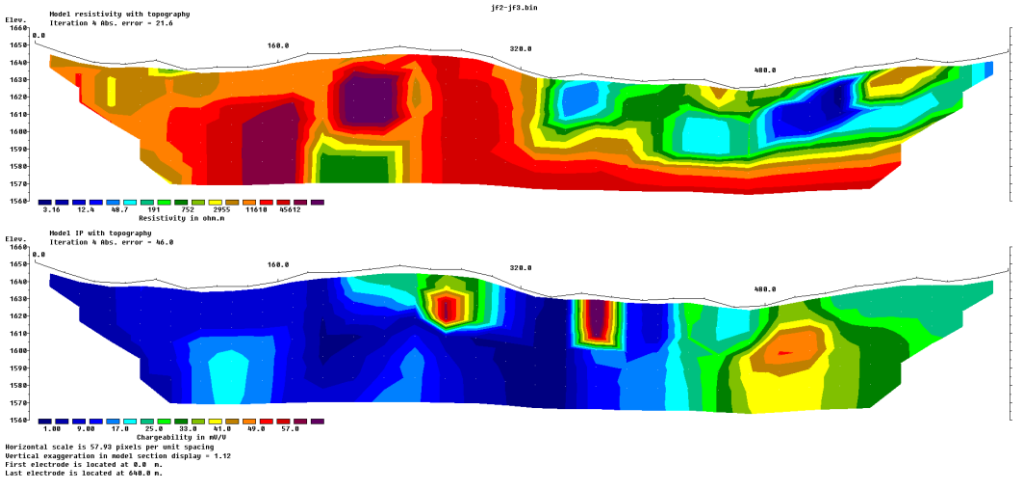

Figure 2. The inverted resistivity and IP sections of the 2nd profile

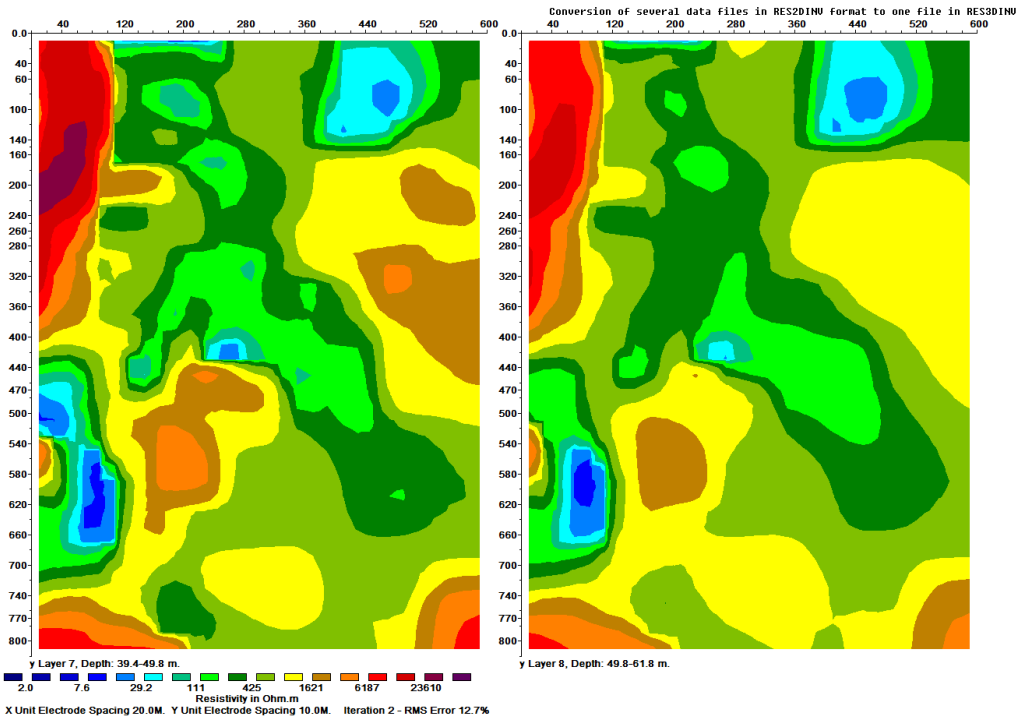

Figure 3. Two-dimensional level maps of 50-61 meter range

Conclusion

It is already known that the Cu-Pb-Zn mineralization produced in the mining area is located in fracture zones and karstic gaps. In this study, these zones were imaged and schematized underground. It is concluded that the IP/Resistivity method can be applied successfully in polymetallic mineralization.

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Stone alterations in Hatuniye Madrasah

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Cite this study: Dal, N., Ergin, Ş., Biçen Çelik, A., & Ay, İ. (2023). Stone alterations in Hatuniye Madrasah. Advanced Engineering Days, 7, 77-80

Keywords
Mardin
Hatuniye Madrasah
Stone Alteration
Types of Alteration
Traditional Stone Buildings

Abstract

The durability of the stone in traditional buildings is effective in the survival of the buildings to the present day. External environmental effects cause alterations on these stones. Determining these alterations and their causes and presenting solution suggestions will ensure that the structures will survive longer. In this study, it is aimed to examine the alterations occurring in Hatuniye Madrasah. In this framework, the alterations in the courtyard and exterior walls of the building were examined and classified as physical, chemical, biological and anthropogenic. The distribution of the alterations in the courtyard and exterior façades of the building was analyzed and it was aimed to form a basis for the determination of the existing problems and the causes of the alterations for the repair projects to be carried out.

Introduction

Mardin has hosted different civilizations throughout history due to its geographical location [1]. Civilizations living in Mardin have built many buildings in the city. While some of these buildings have survived to the present day with the same function, some of them have survived to the present day using different functions [2]. Among these buildings, madrasas served as educational and cultural buildings [3].

Limestone was used in historical buildings in Mardin. Limestone is subject to alteration over time due to adverse climatic conditions, traffic intensity, user error, internal and external factors [4-6]. In some cases, the alterations occurring in the structures prepare the environment for the formation of another alteration. In order to prevent alterations in buildings, it is important to identify the alterations, investigate the causes of alterations and transfer them to future years [7, 8]. The study is aimed to provide an important basis for the identification of existing problems and their causes in terms of repair interventions [9].

Material and Method

In this study, the alterations on the stone surfaces of the courtyard and facades of the Hatuniye Madrasah in Mardin, which were exposed to external environmental conditions, were analyzed. Alterations on the walls of the building were identified and classified [10]. The alterations in the building were classified and analyzed as physical, chemical, biological and anthropogenic alterations [11].

Results and Discussion

Alterations occur over time in stone exposed to external factors such as climatic factors such as pressure, temperature and wind, natural factors and human effects [12]. The strength of the stone decreases over time due to alterations. In order to prevent the alterations occurring in the stone and to transfer them to future generations, they should be identified and measures should be taken [13, 14].

Surface losses that occur as a result of mechanical effects on the stone surface are expressed as physical alteration. Examples include fractures, cracks, fragment breaks, deformation, abrasion, cuts, honeycombing and hairline cracks [15, 16].

The type of alteration that occurs on the surface of the stone as a result of atmospheric events is called chemical alteration. Examples such as color change, salting, crystallization (blooming), crusting, blistering, sugaring and foliation are examples of chemical alteration [11].

The types of alteration caused by organic substances on the surface of the stone are called biological alteration. Moss formation, plant formation, biological accumulation is among the types of biological alteration [17, 18].

Alterations that occur as a result of destruction such as misapplication, misuse and periodic wear and tear given to the structures by humans are called anthropogenic alteration [19].

The limestone, which is the main material of the building, has been subjected to physical alterations such as fragment breakage, joint discharge (Figure 1a), capillary crack (Figure 1b) and abrasions due to the effect of dust carried by wind (Figure 1c and 1d).

Figure 1. Physical alterations at Hatuniye Madrasah (November, 2019)

Chemical alteration types such as salination, discoloration and bacterial growth were observed in Hatuniye Madrasah. Discoloration was observed on the inner courtyard façade (Figure 2a) and the main façade (Figure 2b). Salination (Figure 2c) and bacterial growth (Figure 2d) were also observed.

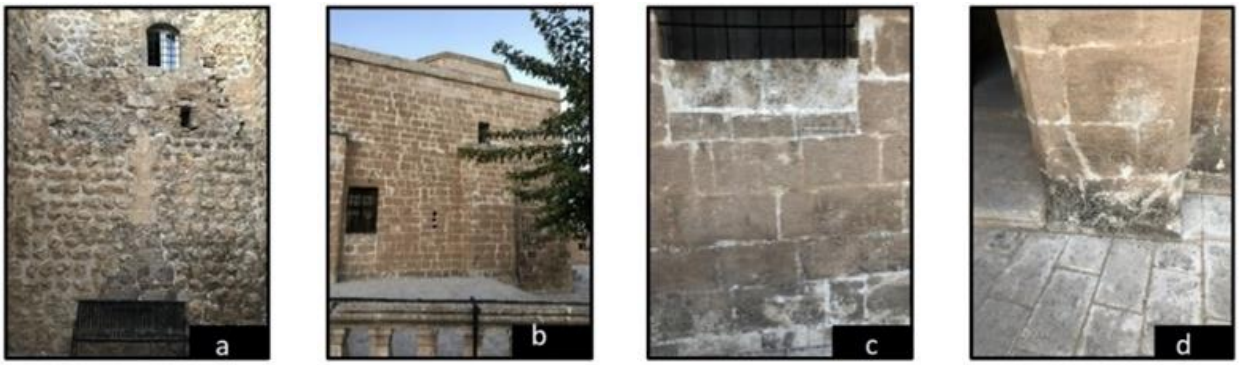

Figure 2. Chemical alterations at Hatuniye Madrasah (November, 2019)

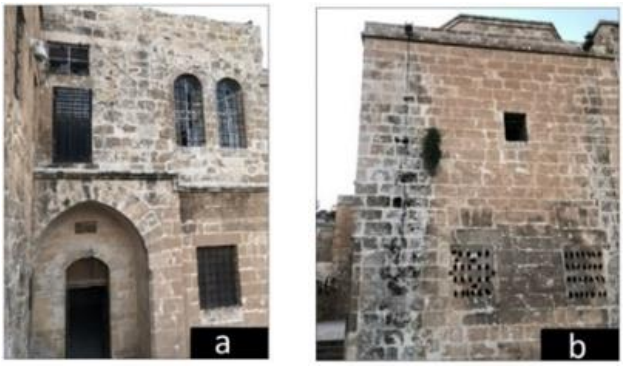

Figure 3. Biological alterations at Hatuniye Madrasah (November, 2019)

Figure 4. Anthropogenic alterations at Hatuniye Madrasah (November, 2019)

Plant formation is encountered as biological alteration in Hatuniye Madrasah. The plant formations on the south and east facades of the building are shown in Figure 3.

Alterations were observed in Hatuniye Madrasah due to the use of sharp tools as a result of anthropogenic effects (Figure 4).

Conclusion

In this study, the alterations that occurred in Hatuniye Madrasah were analyzed. These alterations were determined as a result of visual analysis and then grouped into certain categories. According to the grouping, it was determined that the most common type of alterations occurring in the structure is chemical alteration and the least common type of alteration is anthropogenic alterations.

As a result of the analyses, the facade distributions of the alterations occurring in the structure are shown in Table 1. Accordingly, physical and chemical alterations were observed on all facades. Biological and anthropogenic alterations were also observed on different facades (Table 1).

Table 1. Alterations on the facades of Hatuniye Madrasah

Hatuniye Madrasah	Physical Alterations				Chemical Alterations			Biological Alterations		Anthropogenic Alterations	
	Abrasion	Capillary Crack	Joint Discharge	Part Breakage	Colour Change	Salinisation	Bacteria	Plant Formation	Moss Formation	Sharp Tool Use	Paint Usage
South Facade	+	+	+	+	+	+	+	+	-	-	-
East Facede	+	+	+	+	+	+	+	+	-	+	-
South Facing Courtyard Facade	+	+	+	+	+	+	+	-	-	-	-
West Facing Courtyard Facade	+	+	+	+	+	+	+	-	-	-	-

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Stone alterations in Kasımiye Madrasah

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Cite this study: Ay, İ., Dal, M., Ergin, Ş., & Biçen Çelik, A. (2023). Stone alterations in Kasımiye Madrasah. Advanced Engineering Days, 7, 81-84

Keywords
Mardin
Kasımiye Madrasah
Stone Alteration
Types of Alteration
Traditional Stone Buildings

Abstract

The durability of the stone in traditional stone structures plays an important role in the survival of the structures to the present day. Alteration occurs on the stone surface of the structures exposed to climatic and environmental effects. The correct determination of these alterations and the reasons for their occurrence and the preparation of appropriate solutions will ensure that the structures will survive longer. In this context, this study aims to examine the alterations occurring in Kasımiye Madrasah. In this framework, the alterations occurring on the exterior and courtyard facades of the building were examined and grouped as physical, chemical, biological and anthropogenic. The distribution and ratios of the alterations on the facades were analysed and it was aimed to form the basis for determining the causes of alterations for the repair project.

Introduction

Throughout history, representatives of different cultures, civilisations, peoples, languages and religions have lived peacefully together in Mardin [1].

Civilisations living in Mardin built mosques, madrasahs, pavilions, churches, monasteries and tombs that were used for different functions in the city. Among these buildings, madrasahs were used as educational and cultural institutions [2]. The limestone, which is the main construction material of traditional stone buildings in Mardin, is subjected to alterations due to internal and external factors [3-5]. This alteration causes serious problems in buildings unless precautions are taken. It is important to detect the alterations occurring in the building and to take the correct measures in terms of the long-term survival of the buildings [1]. Regular inspection of the structures, cleaning the structure and taking measures to increase its strength play an important role in transferring the structure to future generations [6].

Material and Method

In this study, the alterations occurring in the Kasımiye Madrasah in Mardin were analysed. The deterioration of the stone surfaces of the building was analysed, and the types and causes of the deterioration were determined. The study covers the analysis of the surfaces of the building facades and the facades facing the inner courtyard that have been degraded as a result of environmental conditions. In the study, alterations were identified and these alterations were classified [7]. In line with the data obtained, the alterations occurring in the structure were grouped as physical, chemical, biological and anthropogenic alterations. This study aims to provide an important basis for the interventions to be made to Kasımiye Madrasah.

Results and Discussion

In traditional stone structures, alterations occur on the surface of the stone as a result of the stone facing environmental and climatic factors [8]. These alterations significantly deteriorate the structure of the stone. In some cases, alterations prepare the ground for the formation process of other alterations or accelerate the process

[9]. The alterations in Kasımiye Madrasah are classified as physical, chemical, biological and anthropogenic alterations [10].

Physical alterations on the surface of the stone as a result of climatic and environmental factors are shown in Figure 1. Capillary cracks on the walls (Figure 1a), fragment breaks in the window openings (Figure 1b), fragment breaks in the inner courtyard (Figures 1c and 1d), abrasion caused by dust carried by wind on the south façade (Figures 1e and 1f), fragment breaks, capillary cracks and joint discharges on the main portal and west façade of the building (Figures 1h and 1g) and abrasion on the entrance staircase due to visitor flow (Figure 1i). These observed degradations negatively affect minerals that increase strength and facilitate physical decomposition [11, 12].

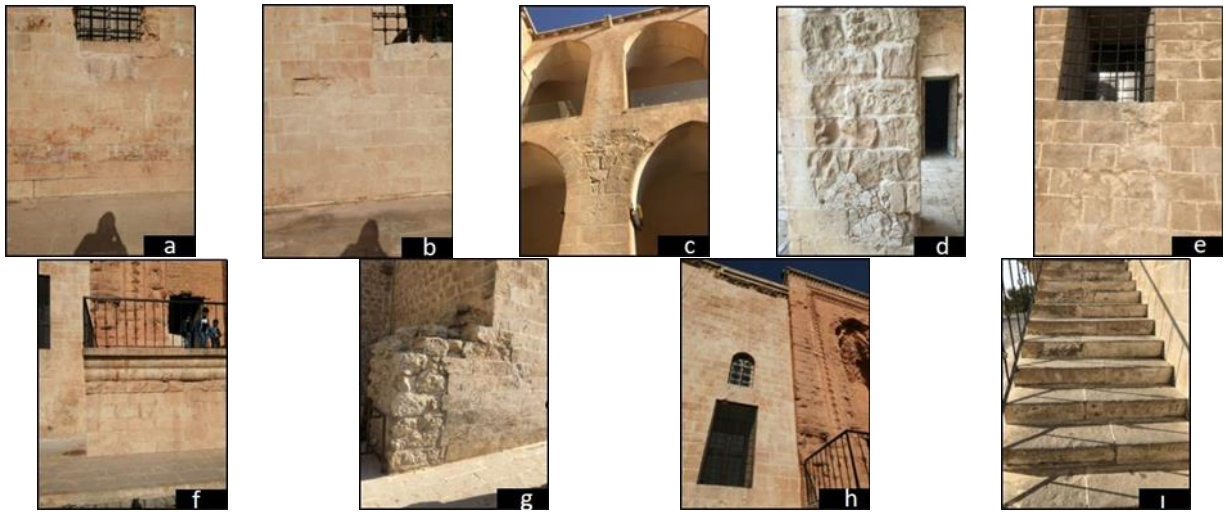

Figure 1. Physical alterations at Kasımiye Madrasah (November 2019)

Chemical alterations are the type of degradation on the surface of the stone as a result of atmospheric events. Salination and colour changes in the structure due to climatic factors are shown in Figure 2. Salination caused by the dissolution and evaporation of the salts in the limestone under the influence of humidity and temperature (Figure 2a, 2b and 2c) and colour changes caused by the interaction of the minerals in the stones (Figure 2d, 2e and 2f) were observed.

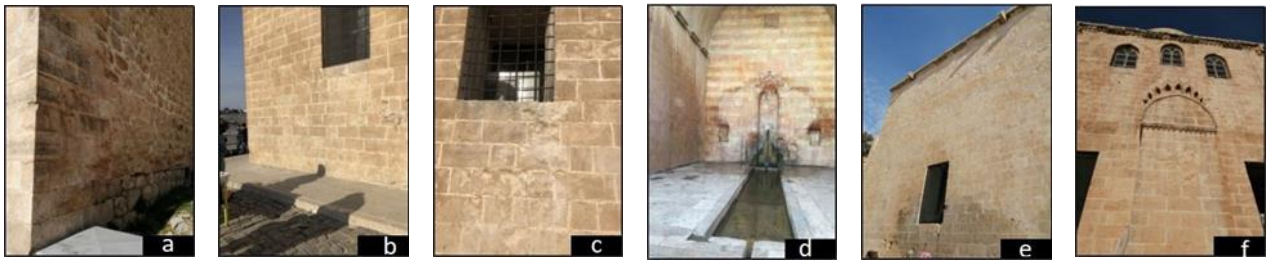

Figure 2. Chemical alterations at Kasımiye Madrasah (November 2019)

Biological alterations in the structure are shown in Figure 3. Plant formations are observed as a result of the interaction of the seeds that settle inside the capillary cracks with water [13]. Plant formations on the south façade (Figure 3a) and east façade (Figure 3e), biochemical alterations caused by bacteria settled on the stone surfaces (Figure 3b and 3c), alterations caused by bird droppings (Figure 3d) and moss formations in the iwan (Figure 3e) were observed.

Figure 3. Biological alterations at Kasımiye Madrasah (November 2019)

The anthropogenic alterations seen on different facades as a result of the damage caused to the structure by unconscious users with sharp tools are shown in Figure 4.

Figure 4. Anthropogenic alterations at Kasımiye Madrasa (November 2019)

Conclusion

As a result of the investigations carried out in Kasımiye Madrasah, it was observed that the rate of chemical alteration was the highest while anthropogenic alteration was the lowest. Capillary cracks, abrasion, joint discharges and fragment breaks were observed as physical alteration types; discolouration and salting were observed as chemical alteration types; bacterial growth, plant growth and moss species were observed as biological alteration types, while sharp tools and paint usage were observed as anthropogenic alteration types.

When analysed on façade basis, physical degradation and chemical degradation types were found on all façades. Biological degradation types were observed on the south, east and south facing courtyard facade of the building. anthropogenic degradation types were observed on the south, west facing courtyard facade and south facing courtyard facade of the building (Table 1).

Table 1. Alterations on the facades of Kasımiye Madrasah

Kasımiye Madrasah	Physical Alterations				Chemical Alterations			Biological Alterations		Anthropogenic Alterations	
	Abrasion	Capillary Crack	Joint Discharge	Part Breakage	Colour Change	Salinisation	Bacteria	Plant Formation	Moss Formation	Sharp Tool Use	Paint Usage
South Facade	+	+	+	+	+	+	+	+	-	+	+
East Facade	+	+	+	+	+	+	+	+	-	-	-
West Façade	+	+	+	+	+	+	+	-	-	-	-
South Facing Courtyard Facade	+	+	+	+	+	+	+	-	+	+	-
West Facing Courtyard Facade	+	+	+	+	+	+	+	-	-	+	+

The data obtained from this study should be utilised in order to provide effective solutions for building conservation projects planned in the coming years. In order for a building to survive for a longer period of time, it is important to take necessary measures to slow down or stop structural alterations in buildings. In order for the buildings to be transferred to future generations, it is of critical importance to correctly identify and evaluate deterioration and to establish improvement techniques.

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Stone alterations in Şehidiye Madrasah

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Cite this study: Ergin, Ş., Biçen Çelik, A., Ay, İ. & Dal, M. (2023). Stone alterations in Şehidiye Madrasah. Advanced Engineering Days, 7, 85-88

Keywords
Mardin
Şehidiye Madrasah
Stone Alteration
Types of Alteration
Traditional Stone Buildings

Abstract

The durability of stone, which is the main construction material of traditional stone buildings, plays an important role in the transfer of the buildings to future generations. Alterations occur in these stones as a result of external environment and climate effects. The causes, processes and solution proposals of these alterations are important for the survival of the buildings. For this purpose, the alterations in Şehidiye Madrasah were analyzed. Alterations occurring on the facades of the building were identified and classified. The classification was made as physical, chemical, biological and anthropogenic. It is aimed that the study will form the basis for the presentation of solution proposals according to the alterations occurring in the structure in the repair projects planned to be carried out in the coming years.

Introduction

In Mardin, which has hosted different cultures and civilisations, buildings with different functions such as mosques, madrasas, mansions, churches, monasteries and tombs were built [1]. Madrasahs, one of the important buildings, were used for educational and cultural purposes [2].

Looking at the traditional stone buildings in Mardin, it is observed that the main material of the building is limestone. Limestone undergoes changes when exposed to internal and external factors due to its structure [3-7]. In order to transfer the buildings to future generations, it is of great importance to determine the changes that occur, to investigate the causes and to offer solutions [1]. The study aims to provide a basis for repair projects and to form the basis for investigating the causes of the changes and taking measures [8].

Material and Method

In this study, the alterations on the facades of Şehidiye Madrasah in Mardin were analyzed. The alterations occurring on the stone surface were analyzed and their causes were determined. The study covers the alterations on the south, east and west facades of the building [8]. The changes in the structure were classified and analyzed as physical, chemical, biological and anthropogenic changes [9].

Results and Discussion

Changes occur in stone over time as a result of exposure to natural and anthropogenic influences as well as environmental factors such as pressure, temperature, wind [10]. Over time, as a result of the changes, the strength of the stone is observed to decrease. It is important to detect alterations in the stone and take measures to transfer them to future generations [11, 12].

Surface losses on the surface of the stone as a result of internal and external factors are called physical alteration. Examples of these are fractures, cracks, fragment breaks, deformation, abrasion, cuts, honeycombing and capillary cracks [13, 14].

The physical alteration of the structure is shown in Figure 2. Physical alteration types such as capillary cracks, joint failure, fragment rupture and surface abrasion were observed. Due to the climatic conditions of Mardin province, the structure was exposed to thermal shock and capillary cracks occurred in the limestone which constitutes the main material of the structure (Figure 2a). Joint failure (Figure 2b, Figure 2c) and fragmentation

(Figure 2d, Figure 2e) were observed. Dust grains carried by the wind caused surface abrasions (Figure 2f) on the façade of the building over time.

Figure 1. Physical alterations at Şehidiye Madrasah (November 2019)

The limestone, which constitutes the main material of the Şehidiye Madrasah, has undergone chemical alteration over time due to internal or external factors. These alterations are given in Figure 2. Discolouration is observed on the main portal providing access to the building (Figure 2a). It is also possible to observe discolouration on the façade facing the inner courtyard of the building, where the women's masjid is also located (Figure 2b). In the Şehidiye Madrasah, it was observed that salting of limestone occurred as a result of interaction with air (Figure 2d and Figure 2e). It is also possible to see bacterial formations on the limestone (Figure 2c and Figure 2f).

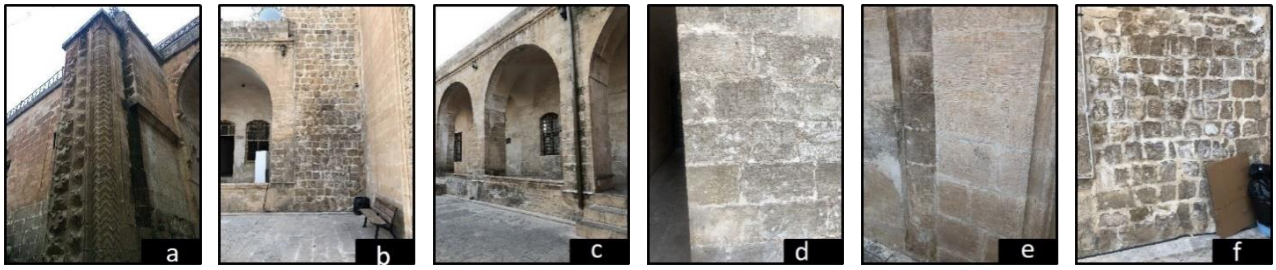

Figure 2. Chemical alterations at Şehidiye Madrasah (November 2019)

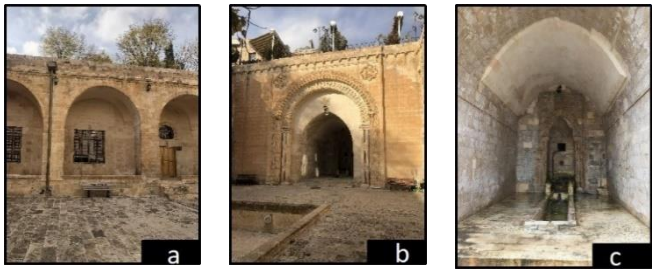

Figure 3. Biological alterations at Şehidiye Madrasah (November 2019)

Organic substances on stone surfaces cause alterations. These are called biological alterations. Algae formation, plant formation, biological accumulation is among the types of biological alteration [15, 16]. The biological alteration of the Şehidiye Madrasah is shown in Figure 3. Plant growth was observed on the façade of the women's masjid (Figure 3a) and the façade of the selsebil (Figure 3b), and moss growth was observed in areas that interact with water (Figure 3c).

In Şehidiye Madrasah, anthropogenic alterations were observed on the north-facing courtyard façade of the building as a result of sharp tools (Figure 4).

Figure 4. Anthropogenic alterations at Şehidiye Madrasah (November 2019)

Conclusion

In this study, the alterations that occurred in Şehidiye Madrasah were analyzed. These alterations were determined as a result of visual analysis and then grouped into certain categories.

When it was analyzed that occurred in Şehidiye Madrasah, it was determined that there were mostly chemical alterations in the structure and the least alterations that occurred as a result of human impact. When these alterations were analyzed in their sub-categories, it was determined that the most common type of physical alteration was surface abrasion and the least was fragment rupture. When chemical alterations were considered, discolouration and salting were the most common and bacterial formation was the least common. When biological alterations were considered, moss formation was the most common and plant formation was the least common. The use of sharp tools was encountered only in one stone as a type of alteration caused by human impact (Table 1).

Table 1. Alterations on the facades of Şehidiye Madrasah

Şehidiye Madrasah	Physical Alterations				Chemical Alterations			Biological Alterations		Anthropogenic Alterations	
	Abrasion	Capillary Crack	Joint Discharge	Part Breakage	Colour Change	Salinisation	Bacteria	Plant Formation	Moss Formation	Sharp Tool Use	Paint Usage
East Facade	+	+	+	+	+	+	+	+	-	-	-
South Facing Courtyard Facade	+	+	+	+	+	+	+	+	+	-	-
North Facing Courtyard Facade	+	+	+	+	+	+	+	-	-	-	-
East Facing Courtyard Facade	+	+	+	+	+	+	+	+	-	+	-

In the conservation and restoration projects that will be carried out in the upcoming years, the data obtained should be taken into account, and solutions should be suggested based on these data. The building should undergo some modifications, but they should be stopped and minimized.

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Stone alterations in Zinciriye Madrasah

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Cite this study: Biçen Çelik, A., Ay, İ., Dal, M., & Ergin, Ş. (2023). Stone alterations in Zinciriye Madrasah. Advanced Engineering Days, 7, 89-91

Keywords
Mardin
Zinciriye Madrasah
Stone Alteration
Types of Alteration
Traditional Stone Buildings

Abstract

The durability of the stone used in traditional buildings is important in the survival of the buildings to the present day. Changes occur over time on the surface of the stone, which is faced with environmental and climatic effects. The causes, processes and solution proposals of these changes are important for the building to survive for a longer period of time. In this context, it is aimed to examine the alterations occurring in Zinciriye Madrasah. In this framework, the alterations on the facades of the building were determined and classified as physical, chemical, biological and anthropogenic alterations. The distributions and ratios of the alterations on the facades were analysed in order to provide a basis for repair projects.

Introduction

Mardin has hosted different cultures, civilisations, peoples, languages and religions due to its geographical location [1]. In this process, mosques, madrasahs, mansions, churches, monasteries and tombs were built by different societies in the city. Some of these structures have survived to the present day with the same function [2]. Among these buildings, madrasahs operated as educational and cultural institutions [3].

Limestone was used in traditional stone buildings in Mardin. Due to its structure, limestone undergoes changes when exposed to internal and external factors [4-7]. It is important to identify the changes, investigate the causes and take precautions in order to transfer the buildings to future generations [1]. In this study, it is aimed to provide a basis for the determination of alterations in Zinciriye Madrasah in the process of preparing repair projects, their causes and taking measures [8].

Material and Method

In this study, the alterations on the facades of Zinciriye Madrasah in Mardin were analysed. The alterations occurring on the stone surface were analysed and their causes were determined. The study covers the alterations on the south, east and west facades of the building [8]. The changes in the structure were classified and analysed as physical, chemical, biological and anthropogenic changes [9].

Results and Discussion

The main construction material of Zinciriye Madrasah is limestone. When limestone is faced with environmental and climatic factors, degradation occurs on the surface of the stone [10]. These deteriorations change the internal structure of the stone. These changes in the stone cause alterations and in some cases accelerate the process of other alterations [11]. The alterations in Zinciriye Madrasah are classified as physical, chemical, biological and anthropogenic alterations [9].

The physical alterations caused by environmental and climatic effects are shown in Figure 1. Capillary cracks (Figure 1a), joint losses (Figure 1b), surface loss (Figure 1c) and fragment losses (Figure 1d) were observed on the facades of the building. These observed degradations negatively affect minerals that increase strength and facilitate physical decomposition [12].

Chemical changes are the type of deterioration that occurs on the surface of the stone as a result of atmospheric events. Salination and colour changes in the structure due to climatic factors are shown in Figure 2. Salination caused by the dissolution and evaporation of salts in limestone under the influence of humidity and temperature (Figure 2a and 2b) and discolouration caused by the interaction of minerals in the stone (Figure 2c and 2d) were observed.

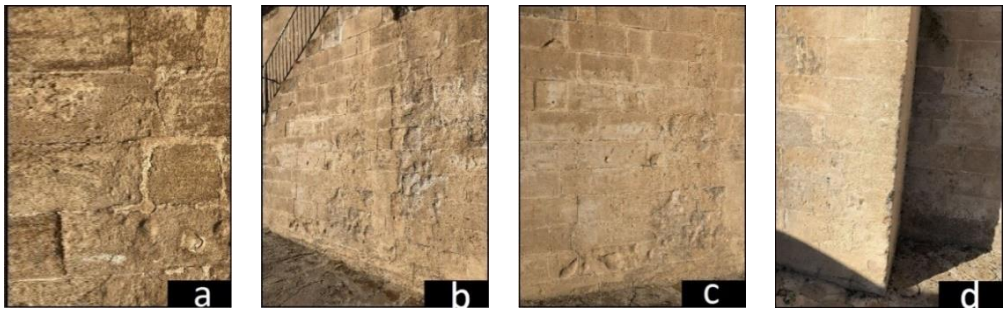

Figure 1. Physical alterations at Zinciriye Madrasah (November 2019)

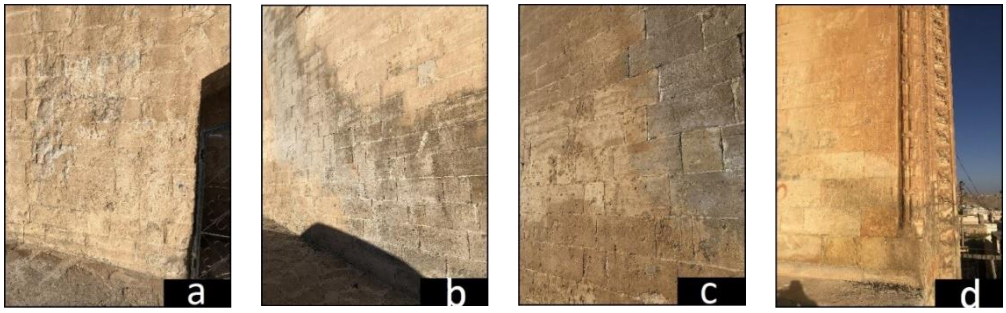

Figure 2. Chemical alterations at Zinciriye Madrasah (November 2019)

Biological changes in the structure are shown in Figure 3. Plant formations are observed as a result of the interaction of the seeds that settle in the capillary cracks with water [13]. Flowering was observed on the south façade of the building (Figure 3a, 3b and 3c) and mossing was observed in the inner courtyard of the building (Figure 3d).

Anthropogenic alterations in the building are shown in Figure 4. The use of paint on the south façade (Figure 4a) and misuse of stone on the staircase (Figure 4b) were observed.

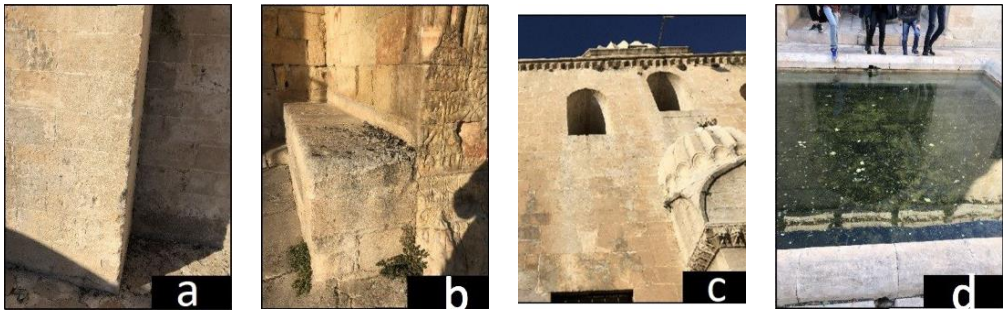

Figure 3. Biological alterations at Zinciriye Madrasah (November 2019)

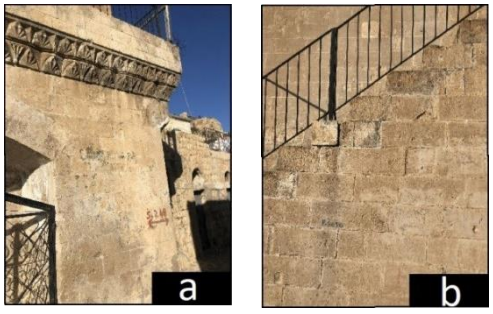

Figure 4. Anthropogenic alterations at Zinciriye Madrasah (November 2019)

Conclusion

In this study, the alterations that occurred in Zinciriye Madrasah were analysed. These alterations were determined as a result of visual analysis and then grouped into certain categories. According to the grouping, it was determined that the most common type of alterations occurring in the structure is chemical alteration and the least common type of alteration is biologic alterations.

When the alterations in Zinciriye Madrasah were analysed, it was observed that chemical alterations were the highest and biological alterations were the lowest. Physical and chemical alteration types were observed on the south, east and west facades of the building. It was determined that the amount of mossing in the madrasah was higher than plant formation. In addition, incorrect stone usage and paint usage were found on the south façade of the building (Table 1).

Table 1. Alterations on the facades of Zinciriye Madrasah

Zinciriye Madrasah	Physical Alterations				Chemical Alterations			Biological Alterations		Anthropogenic Alterations		
	Abrasion	Capillary Crack	Joint Discharge	Part Breakage	Colour Change	Salinisation	Bacteria	Plant Formation	Moss Formation	Sharp Tool Use	Paint Usage	Incorrect Stone Use
South Facade	+	+	+	+	+	+	+	+	-	-	+	+
East Façade	+	+	+	+	+	+	+	+	-	-	-	-
West Façade	+	+	+	+	+	+	+	+	-	-	-	-

The data obtained from this study should be utilised in order to provide effective solutions for building conservation projects planned in the coming years. In order for a building to survive for a longer period of time, it is important to take necessary measures to slow down or stop structural alterations in buildings. In order for the buildings to be transferred to future generations, it is of critical importance to correctly identify and evaluate deterioration and to establish improvement techniques.

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The effect of metal turbulence on hydrogen induced crack defects in steel castings

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Cite this study: Zor, M. M., Tülüce, F., Kesim, S., & Yoloğlu, A. (2023). The effect of metal turbulence on hydrogen induced crack defects in steel castings. Advanced Engineering Days, 7, 92-95

Keywords
Hydrogen induced cracking
Steel casting
Gating system design
Molding design
Modelling and simulation

Abstract

In the study, various moulding and gating system designs have been designed for steel castings in the ÇİMSATAŞ foundry and the effects of the metal turbulence on hydrogen-induced crack defects have been investigated. The flow and solidification of the casting part were simulated by using Novacast flow and solidification program. The study clearly shows that metal turbulence has revealed that it plays a significant role in preventing hydrogen-induced crack defects in steel castings.

Introduction

Hydrogen cracking is characterized by its fine, hairline stepped appearance linking inclusions. Turbulence during the pouring of metals generates two main defects: (1) entrained air bubbles and (2) entrained oxide films from the surface of the liquid metal [1-9]. The oxides are always entrained with the dry top surface of the oxide folded over against itself. This unbonded double interface (a bifilm) acts as a crack in the liquid metal, leading to the initiation of cracks and hot tears in the casting [10-19].

Material and Method

The material of the casting part is determined according to the SEW 520 standard and material of the casting part has been selected as G 14NiCrMo10-6. The part with two different molding and gating systems have been molded in the flaskless resin molding system and casted in ÇİMSATAŞ foundry. The image of the casting part is shown in Figure 1.

Figure 1. Schematic representation of the casting part

In the first casting design study, gating system design of the casting part is based on total gross weight of the part and effective casting height. The gating system ratio of the casting part has been choosen as 1:3:1. The molding and gating system designs have been designed by using solid data and then, flow and solidification of the casting part has been simulated at 1600°C by choosing lip pouring ladle. The images of the simulation results of the casting part are shown in Figure 2.

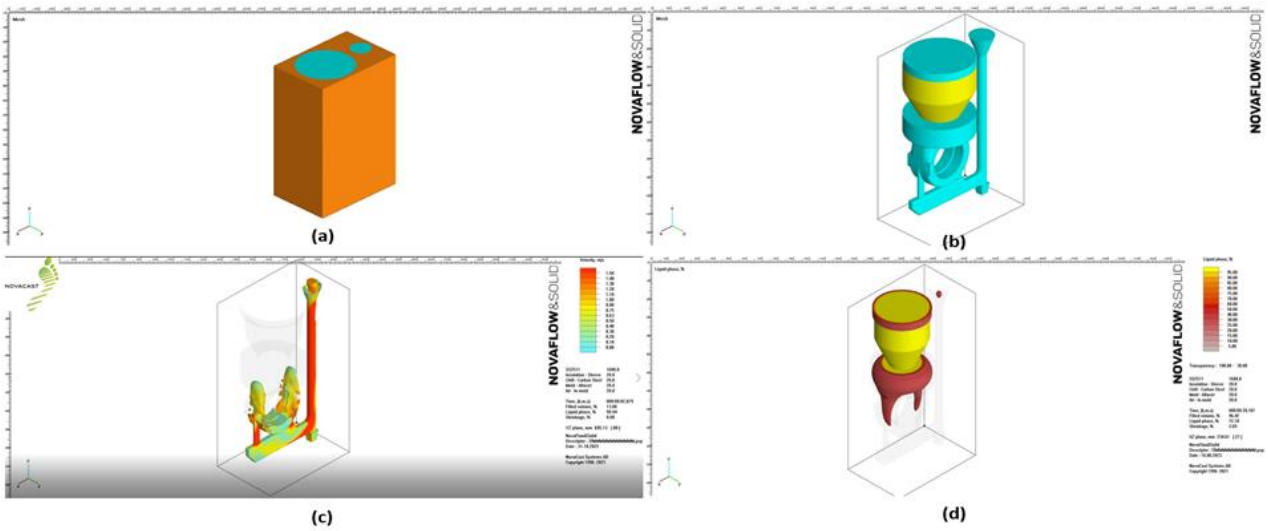

Figure 2. (a); The image of the molding design of the casting part, **(b);** The image of the casting part geometry, **(c);** The image of the metal flow and filling simulation of the casting part, **(d);** The image of the friction liquid mod of the casting part

After simulation results, one part was molded in the flaskless resin molding system in ÇİMSATAŞ foundry and the casting has been carried out with a lip pouring ladle at 1590 °C. After the casted part was heat treatment (normalizing and tempering), the flange of the casting part was machined according to technical drawing of the part and magnetic particle testing was performed on the part. The locations of the defects and morphologies in the flange of the casting part under UV light after machining are shown in Figure 3.

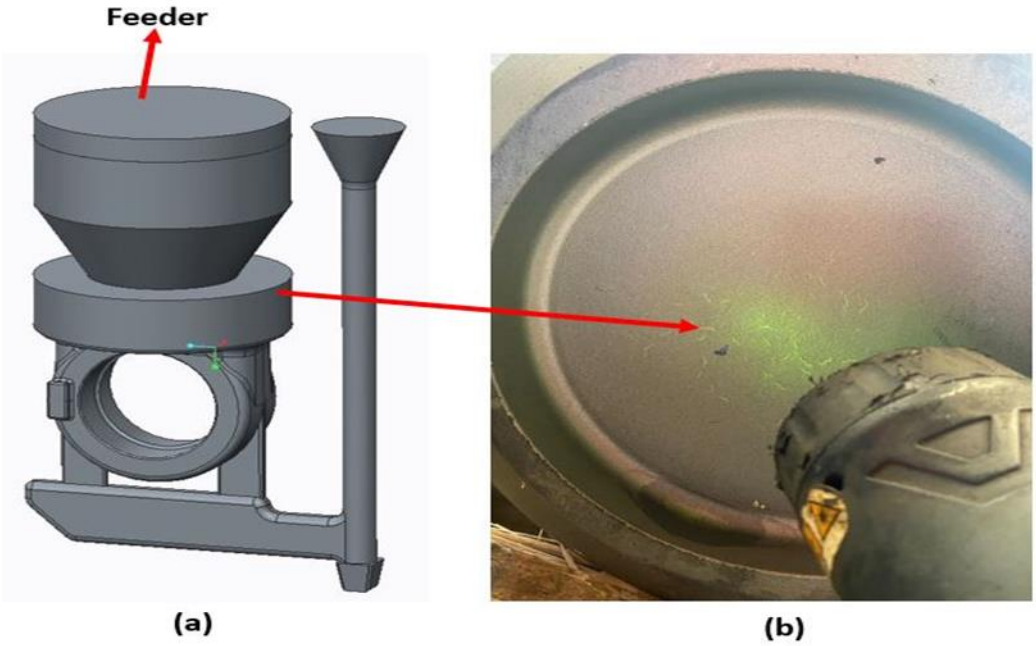

Figure 3. (a); The image of the molding design of the casting part, **(b);** The locations and morphologies of the defects on the flange of the casting part under UV light after machining.

After the first poured part was examined and then molding and gating system designs of the casting part were changed in the part solid data. In the casting part design, the gating system design of the casting part was calculated according to total gross weight and effective casting height of the part. After the molding and gating system designs of the casting part were chanced, flow and solidification of the part was simulated at 1600 °C by choosing lip pouring ladle. The images of the simulation results of the casting part are shown in Figure 4.

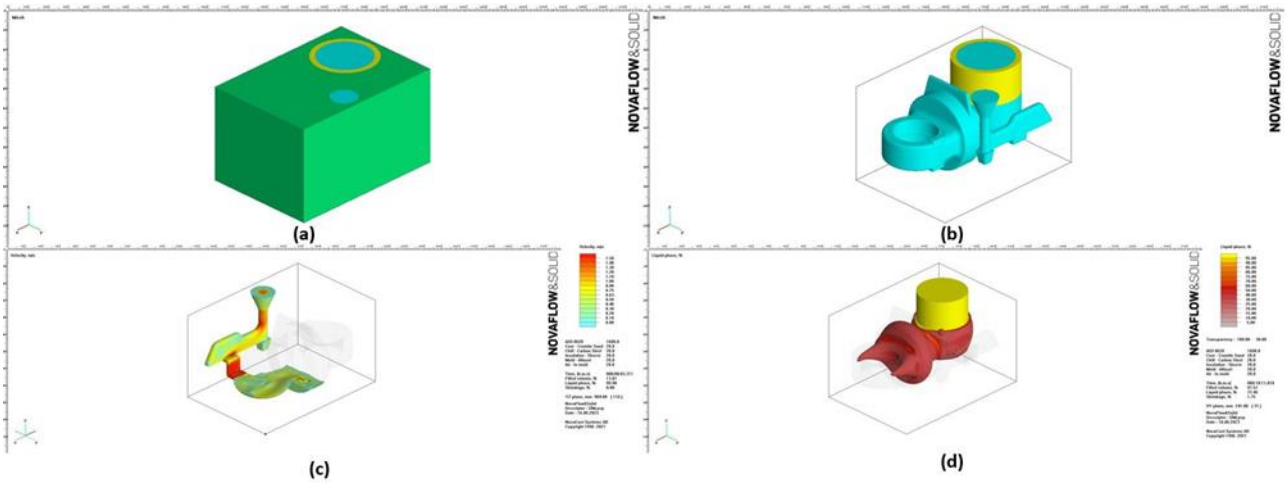

Figure 4. (a); The image of the molding design of the casting part, (b); The image of the casting part geometry, (c); The image of the metal flow and filling simulation of the casting part, (d); The image of the friction liquid mod of the casting part

After simulation results, one part was molded again in the flaskless resin molding system in ÇİMSATAŞ foundry and the casting has been carried out with a lip pouring ladle at 1590 °C. After the casted part with new designed was heat treatment (normalizing and tempering), the flange of the casting part was machined according to technical drawing of the part and magnetic particle testing was performed on the part. It was observed that there were no defects under UV light in the magnetic particle test applied to the flange of the cast part after machining. The locations of the defects and morphologies in the flange of the casting part under UV light after machining are shown in Figure 5.

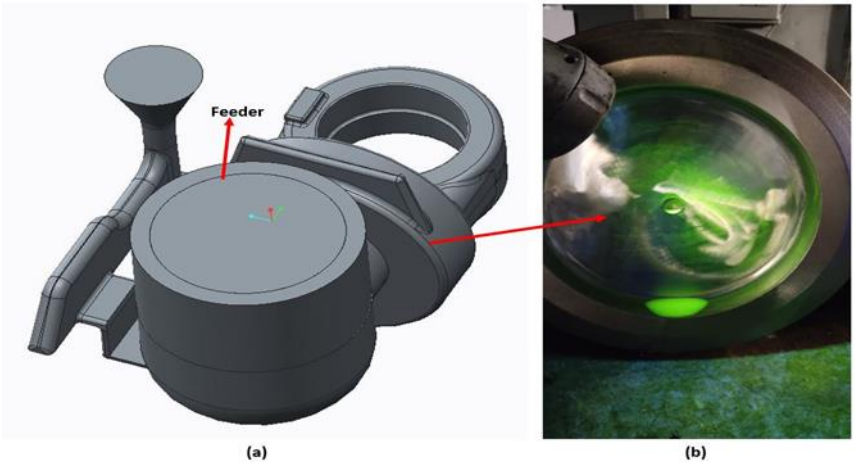

Figure 5. (a); Image of the mold design of the cast part, (b); Image of the flange of the casting part under UV light after machining

Results

- While it was observed that turbulence occurred in the liquid metal in the filling simulation of the first designed casting part, it was observed that there was no turbulence in the liquid metal in the filling simulation of the second casting part designed.
- It has been observed that the turbulence occurring in the liquid metal causes hydrogen-induced defects in the casting part.

Conclusion

In this study, the tried to relationship between hydrogen-induced defects in steel castings and molding and gating system designs were established and it was revealed that hydrogen-induced defects were related to metal turbulence. According to the results of the study, it has been revealed that NiCr, NiCrMo, NiCrMoV steel materials are sensitive to hydrogen-induced crack defects. Turbulence in the liquid metal causes the formation of re-oxidation products in the alloying elements in the liquid metal. In addition, the turbulence in the liquid metal

increases the contact of the free moisture in the mold during the filling period of the molding and therefore causes the formation of hydrogen-induced defects in the steel casting parts.

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Comparison of an 18-story reinforced concrete structure using the response spectrum analysis according to the TSC 2007 and TSC 2019

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Cite this study: İnal, F., & Can, H. (2023). Comparison of an 18-story reinforced concrete structure using the response spectrum analysis according to the TSC 2007 and TSC 2019. Advanced Engineering Days, 7, 96-99

Keywords
Seismic code
Response spectrum analysis
Concrete structures

Abstract

This study utilized TSC 2007 and TSC 2019 seismic codes to investigate the earthquake forces of an 18-story reinforced concrete building with a 35x25m² floor plan using the response spectrum method. Because of the effective cross-sectional stiffness, spectral accelerations are greater in TSC 2007 than in TSC 2019. Even though the structural behavior coefficient was taken to be smaller in TSC 2019 due to the shear wall placement, the shear forces of the previous code are greater. In the new seismic code, the reduction of the stiffness of the load-bearing elements has led to an increase in the period values, which has led to a more ductile behavior of the building.

Introduction

Numerous cities have been founded and thrived in earthquake-prone locations throughout history. The risk of loss of life and property from earthquakes is increasing as cities grow and structure heights rise. As a result, structures in earthquake zones must be earthquake-resistant.

To develop structures, designers and practitioners must comprehend the most recent seismic codes, which serve as the cornerstone of earthquake-resistant structures. In this investigation, the response spectrum analysis approach described in TSC 2007 [1] and TSC 2019 [2] was utilized to investigate an 18-story concrete building, and the results were compared.

Material and Method

Version 17.0.1 of the ETABS program was used in the analysis of the reinforced concrete structure [3]. The class of reinforced concrete elements is selected as C40, the modulus of elasticity of the material is taken as E_c=34000 MPa, while the reinforcement class is B420C, and the modulus of elasticity is E_s=200000 MPa. Dead and live loads applied to the structure are given in Table 1 and Table 2.

Table 1. Dead loads affecting the structure

Concrete load	γ_c = 25 kN/m³
Slab load (Normal story)	g = 1,5 kN/m²
Partition wall	g = 4 kN/m³
Slab load (Rooftop)	g = 4 kN/m³

Effective section stiffness factors, one of the biggest innovations brought by the 2019 Seismic Code, were used in the analyses made according to the TSC 2019, and the stiffness factors of the load-bearing elements were not changed in the analyses made according to the TSC 2007.

Table 2. Live loads affecting the structure

Slab live load	q = 3,5 kN/m²
Rooftop live load	q= 1,00 kN/m²
Snow load	q = 0,75 kN/m²

İstanbul/Avcılar was chosen as the place where the structure will be built. According to TSC 2007, the soil class was designated as Z3, while according to TSC 2019, the soil class was selected as ZD.

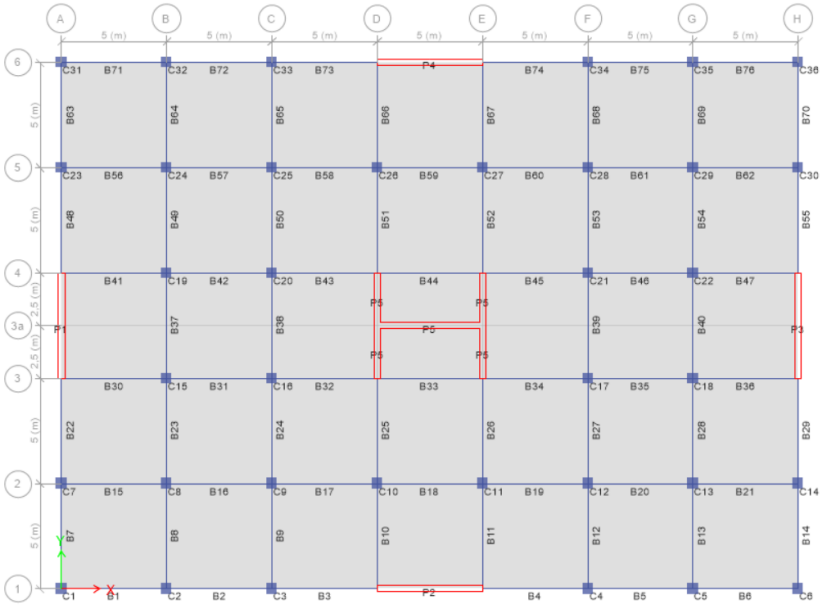

Figure 1. Floor plan of the building

The height of all floors is 3 m. The floor plan of the building is shown in Figure 1, the sectional and perspective views are shown in Figure 2. The building was planned to be used as a residence, the floors were considered as a rigid diaphragm, and ±5% additional eccentricities were calculated in two vertical directions perpendicular to each other.

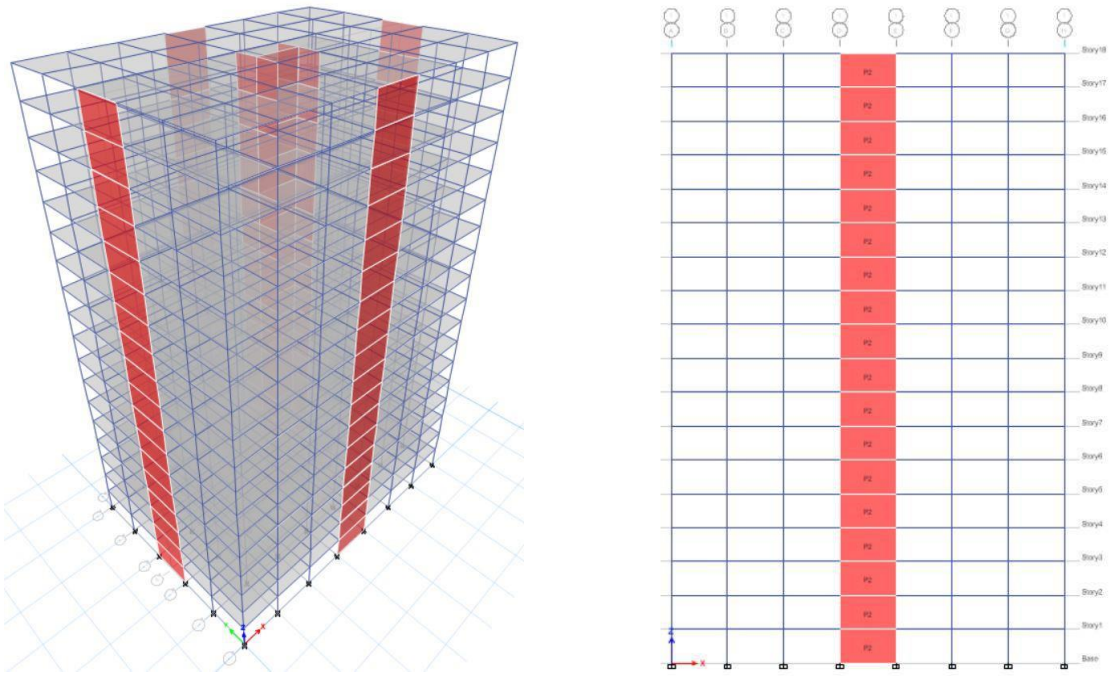

Figure 2. Perspective and 1-1 cross-sectional view of the 18-story building

Table 3 gives the overturning moment (ΣM_{DEV}) values of the shear walls of the structure and the overturning moments (ΣMo) for the building due to seismic loads.

Table 3. Overturning moments of the shear walls and the building

Shear walls	X-X Direction Bending Moment (kNm)	Y-Y Direction Bending Moment (kNm)
P1	365	86242
P2	82106	358
P3	365	86242
P4	82106	358
P5	342890	173224
ΣM_{DEV}	507833.01	346425.99
ΣM_o	1876274	1731952

Table 4 shows that the overturning moment calculated for the whole building (M_o) is less than 1/3 of the calculated earthquake direction for any of the shear walls.

Table 4. $M_o/3$ control in the 18-story structure

Shear walls	X Direction $\Sigma M_{DEV}/\Sigma M_o$	Y Direction $\Sigma M_{DEV}/\Sigma M_o$
P1	0.02%	4.98%
P2	4.38%	0.02%
P3	0.02%	4.98%
P4	4.38%	0.02%
P5	18.28%	10.00%

In Table 5, the sum of the base overturning moment of the shear walls (M_{DEV}) at the side axis of the building is less than 1/6 of the total overturning moment for the entire structure (M_o) consequently structural response coefficient (R) will be used as 5.60.

Table 5. $M_o/6$ control in the 18-story structure

Shear walls	X Direction $\Sigma M_{DEV}/\Sigma M_o$	Shear walls	Y Direction $\Sigma M_{DEV}/\Sigma M_o$
P2	4.38%	P1	4.98%
P4	4.38%	P3	4.98%

Results and Discussion

Figure 3 shows the distribution of the moments derived in the X and Y directions of the chosen columns on the first floor as a result of analyses performed using the Response Spectrum Method as stipulated in the 2007 and 2019 seismic codes. TSC 2019 moment values were higher in both directions than the preceding code.

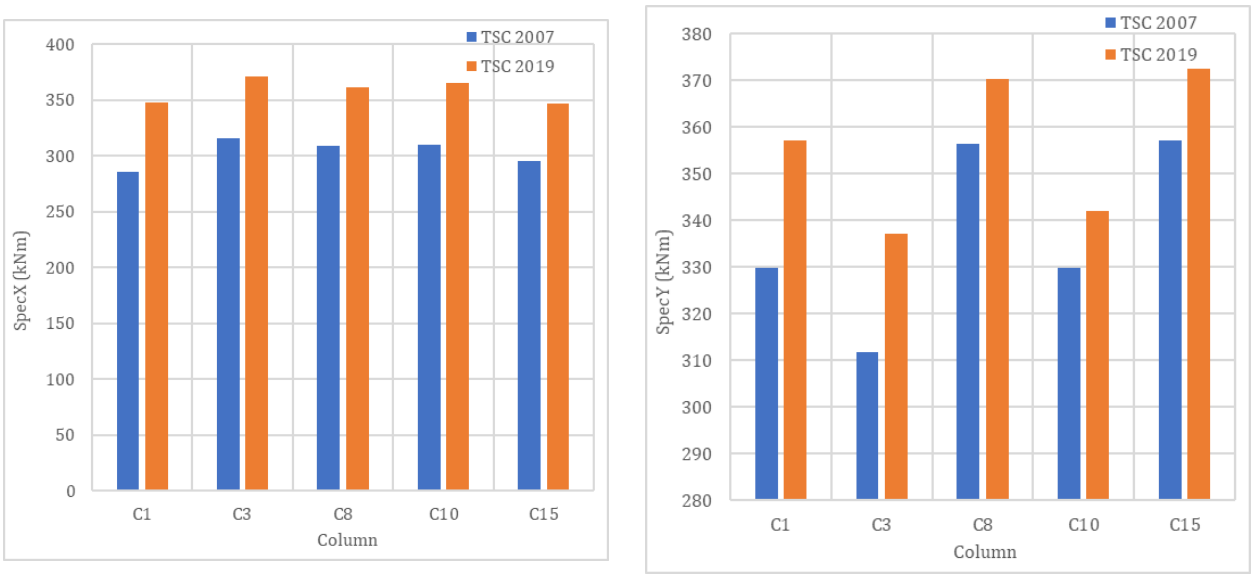

Figure 3. Moment values according to response spectrum analysis in the X and Y directions

In Table 6, changing the effective sectional stiffness of the load-bearing elements has led to a longer period of the structure, which has led to lesser shear forces in the current code. Although the new code penalizes the

structure due to the location of the shear walls, the seismic forces of the previous code are still higher than those of the 2019 TSC.

Table 6. Shear forces according to response spectrum analysis

	TSC 2007				TSC 2019			
	T (sec)	Structural Behavior Coefficient (R)	Spectral Acceleration (g)	V_{tx} (kN)	T (sec)	Structural Behavior Coefficient (R)	Spectral Acceleration (g)	V_{ty} (kN)
X Direction	1.22	7.00	≈0.567	12197.26	1.843	5.60	≈0.365	11337.06
Y Direction	1.335	7.00	≈0.527	12741.63	2.006	5.60	≈0.345	10380.49

Conclusion

When the results of the analysis made according to both seismic codes are examined, it has been determined that the structure solved with the TSC 2019 exhibits a more ductile behavior, since the effective section stiffness is taken into account. Compared to the horizontal elastic design spectra of both seismic codes, the spectral accelerations of the TSC 2007 are higher. This leads to a higher computation of the shear forces determined by the response spectrum analysis in the 2007 code. However, when the selected columns on the first floor are examined, it is observed that the moment values in the new code are 18% higher in the X direction and 6% higher in the Y direction than in the prior regulation.

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The role and essence of ill-posed problems for solving various applied problems

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Cite this study: Juraev, D. A., Elsayed, E. E., Bulnes, J. D., & Agarwal, P. (2023). The role and essence of ill-posed problems for solving various applied problems. Advanced Engineering Days, 7, 100-102

Keywords
Ill-posed problems
Carleman function
Helmholtz equation
Approximate solution
Cauchy problem

Abstract

In this paper, the history of the appearance of ill-posed problems and the role and essence of these problems in solving various problems of equations of mathematical physics are described in detail. At the present time, the theory and application of ill-posed problems in various fields of science is rapidly developing. When solving ill-posed problems, we will construct a Carleman function and, on its basis, we will find in an explicit form an approximate solution of the problem.

Introduction

Many problems of an applied nature, such as geo- and biophysical, electrodynamic, gas-, hydro- and aerodynamic, problems of plasma physics, etc., are reduced to the equations of mathematical physics. In fact, the very construction of an equation of mathematical physics, which adequately describes certain physical laws of the world around us, is a solution to a certain problem, which it is natural to call "inverse". The researcher observes a phenomenon and tries to construct an equation whose solution has the observed properties. Usually, the resulting equations are based on physical laws that allow us to formulate the general form of differential relations. As a rule, they contain a certain number of arbitrary functions that determine the properties of the physical medium. If the properties of the medium are known, then the equation of mathematical physics, combined with the boundary and initial conditions, makes it possible to predict the development of a physical phenomenon in the space-time region. This is a classic problem for the equations of mathematical physics. In the theory of inverse problems such problems are called "direct". In modern natural science, the following inverse problems very often arise: the general form of the equation of mathematical physics is known, but the characteristic properties of the medium are not known, they must be determined from the observed solutions of the equation. A typical situation is when direct measurements inside a certain area are impossible for one reason or another, however, indirect observation and qualitative and quantitative measurements of physical fields at the boundary or outside this area are possible. In mathematical terms, such problems should ensure the correctness of the problem statement.

The concept of the correctness of a problem statement in mathematical physics was formulated at the beginning of the 20th century by the famous French mathematician J. Hadamard [8]. A problem of mathematical physics is called well-posed if the following conditions are met:

1) the solution of the problem exists;
2) the solution of the problem is unique;
3) the solution of the problem continuously depends on the data of the problem.

Having formulated the concept of correctness, J. Adamar gave an example of an ill-posed problem for an equation of mathematical physics, which, in his opinion, did not correspond to any real physical formulation. J. Hadamard showed this on the example of the Cauchy problem for the Laplace equation, which has become a classic example of an ill-posed problem. The need to consider problems of mathematical physics that are incorrect in the classical sense (according to Hadamard) in connection with the problems of interpreting geophysical observational data was first indicated in 1943 by the twice Hero of Socialist Labor, Academician of the USSR Academy of Sciences A.N. Tikhonov. He showed that if the class of possible solutions is reduced to a compact set, then the existence and uniqueness of the solution implies its stability. Ways of development of the theory and methods for solving ill-posed problems are associated with the names of prominent mathematicians A.N. Tikhonov, M.M. Lavrentiev, V.K. Ivanov, as well as with the scientific mathematical schools they created, which largely determined the development of theories and applications of ill-posed problems. A large number of problems in mathematical physics that do not satisfy the Hadamard correctness conditions are reduced to an operator equation of the first kind.

Since the problems of mathematical physics describe real processes in nature, they must satisfy certain requirements. The stability requirement means that any physically defined process must continuously depend on the initial and boundary conditions and on the inhomogeneous term in the equation, i.e. should be characterized by functions that change little with small changes in the initial data. Such processes are not physically defined. Stability is also important for the approximate solution of problems. Among mathematical problems, a class of problems stands out, the solutions of which are unstable to small changes in the initial data. They are characterized by the fact that arbitrarily small changes in the initial data can lead to arbitrarily large changes in the solutions. Problems of this type are, in essence, ill-posed. They belong to the class of ill-posed problems.

Development of ill-posed problems in modern mathematical sciences

Tasks that do not satisfy all of the above requirements 1)–3) are, according to Hadamard, incorrectly delivered. In 1926, T. Carleman (see, for instance [3], p. 41) constructed a formula that connects the values of the analytic function of a complex variable at the points of the region with its values on a piece of the boundary of this region. The construction of the Carleman function makes it possible in these problems to construct a regularization and obtain an estimate of the conditional stability. It is known that the Helmholtz equation in different spaces has a fundamentally different solution. In the future, using the construction of constructing a fundamental solution, we will construct an approximate solution for the Helmholtz equation. MM. Lavrent'ev, in his works on the Cauchy problem for the Laplace equation and for some other ill-posed problems of mathematical physics, indicated a method for distinguishing the correctness class and developed stable methods for solving them ([3-6]). M.M. Lavrent'ev proposed the construction of a regularized solution of the Cauchy problem for the Laplace equation using the Carleman function.

Moreover, in the 1977s, Sh. Yarmukhamedov pointed out the construction of a family of fundamental solutions parametrized by an entire function with certain properties [7]. This construction is used to construct explicit formulas that restore solutions of elliptic equations in a domain from their Cauchy data on a piece of the domain boundary. Such formulas are also called Carleman formulas. The multidimensional Carleman formula was constructed by L.A. Aizenberg [11].

In unstable problems, the image of the operator is not closed, therefore, the solvability condition cannot be written in terms of continuous linear functionals. So, in the Cauchy problem for elliptic equations with data on a part of the boundary of a domain, the solution is usually unique, the problem is solvable for an everywhere dense data set, but this set is not closed. Consequently, the theory of solvability of such problems is much more difficult and deeper than the theory of solvability of the Fredholm equations. The first results in this direction appeared only in the mid-1980s in the works of L.A. Aizenberg, A.M. Kytmanov and N.N. Tarkhanov [10]. An analogue of the Carleman formula for one class of elliptic systems with constant coefficients on the plane is considered in the work of E.V. Arbuzov and A.L. Bukhgeim [12]. The construction of the Carleman matrix for elliptic systems was carried out by Sh. Yarmukhamedov, N.N. Tarkhanov, A.A. Shlapunov, I.E. Niyozov and others. In papers [9-14] The questions of exact and approximate solutions of the ill-posed Cauchy problem for various factorizations of the Helmholtz equations are studied. Such problems arise in mathematical physics and in various fields of natural science (for example, in electro-geological exploration, in cardiology, in electrodynamics, etc.). Using the construction of previous works, the validity of the fundamental solution for the matrix factorization of the Helmholtz equation in various spaces was proved in the works [15-24]. The solution of the heat equation by solving the integro - differential equation and unusual quantum entanglement consistent with the Schrödinger equation were considered in works [25-27].

Conclusion

Hadamard believed that any mathematical problem corresponding to any physical or technical problem should be correct, since it is difficult to imagine what physical interpretation the solution can have if arbitrarily

small changes in the initial data can correspond to large changes in the solution. This called into question the expediency of studying ill-posed problems (examples are given by Hadamard himself). Later it was established that widespread mathematical problems are unstable in certain metrics: the solution of integral equations of the first kind; differentiation of functions known approximately; numerical summation of Fourier series when their coefficient is known approximately; solving systems of linear algebraic equations under conditions of a system determinant close to zero; the Cauchy problem for the Laplace equation; analytic continuation of functions; inverse problems of gravimetry; minimization of functionals; some problems of linear programming and optimal control, as well as optimal design (synthesis of antennas and other physical systems); object control described by differential equations.

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On the Cauchy problem for the Helmholtz equation

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Cite this study: Juraev, D. A., Shokri, A. & Agarwal, P. (2023). On the Cauchy problem for the Helmholtz equation. Advanced Engineering Days, 7, 103-105

Keywords
Integral formula
Matrix factorization
Helmholtz equation
Bounded domain
Cauchy problem

Abstract

The work is devoted to the study of continuation and evaluation of the stability of the solution of the Cauchy problem for the Laplace equation in a domain from its known values on the smooth part of the boundary of the domain. The problem under consideration belongs to the problems of mathematical physics, in which there is no continuous dependence of solutions on the initial data. When solving applied problems, it is necessary to find not only an approximate solution, but also a derivative of the approximate solution.

Introduction

The considered problem belongs to ill-posed problems of mathematical physics. In the work of Tikhonov A.N. [1], the true nature of ill-posed problems of mathematical physics was clarified. He pointed out the practical importance of unstable problems and showed that if we restrict the class of possible solutions to a compact set, then the stability of the solution follows from the existence and uniqueness, i.e. the task becomes sustainable. Formulas that make it possible to find a solution to an elliptic equation in the case when the Cauchy data are known only on a part of the boundary of the domain are called Carleman-type formulas. In [2], Carleman established a formula that gives a solution to the Cauchy-Riemann equations in a domain of a special form. Developing his idea, G.M. Goluzin and V.I. Krylov [3] derived a formula for determining the values of analytic functions from data known only on the boundary segment, already for arbitrary regions. They found a formula for recovering a solution from its values on the boundary set of a positive Lebesgue measure, and also proposed a new version of the continuation formula. It is known that the Helmholtz equation in different spaces has a fundamentally different solution. In the future, using the construction of constructing a fundamental solution, we will construct an approximate solution for the Helmholtz equation. The fundamental solution for the Laplace equation was constructed by Sh. Yarmukhamedov [4]. The fundamental solution for the matrix factorization of the Laplace equation was proved in [5]. Using the construction of work [4], as well as work [5], we prove the validity of the fundamental solution for the Helmholtz equation in the plane case. For the matrix factorization of the Helmholtz equation, the validity of fundamental solutions in various spaces was considered by the author [6-18].

Basic information and formulation of the Cauchy problem

This section deals with the construction of a family of fundamental solutions of the Helmholtz equation, parameterized by an entire function with certain properties.

Let R^2 be a two-dimensional real Euclidean space, $\xi=(\xi_1,\xi_2)\in R^2$, $\eta=(\eta_1,\eta_2)\in R^2$, $\alpha=|\eta_1-\xi_1|$, $r=|\eta-\xi|$.

$G\subset R^2$ is a bounded simply connected region whose boundary consists of a segment $a\le y_1\le b$ and some smooth curve S lying in the half-plane $y_2>0$, i.e., $\partial G=S\bigcup T$.

We consider the Helmholtz equation in domain G

$$\Delta W(\eta)+\lambda^2 W(\eta)=0, \tag{1}$$

where $\lambda>0$, $\Delta-$ is the Laplace operator.

We denote by $\mathrm{N}(w)$ is an entire function taking real values for real w ($w=u+iv$; $u,v-$ real numbers) and satisfying the following conditions:

$$\mathrm{N}(u)\neq 0,\ \sup_{v\geq 1}\left|v^p \mathrm{N}^{(p)}(w)\right|=\mathrm{M}(u,p)<\infty,\ -\infty<u<\infty,\ p=0,1,2. \tag{2}$$

We define a function $\Psi(\eta,x)$ when $\eta\neq\xi$ by the following equality:

$$\Psi(\eta,\xi)=-\frac{1}{2\pi K(\xi_2)}\int_0^{\infty}\mathrm{Im}\frac{\mathrm{N}(w)}{w-\xi_2}\frac{uI_0(\lambda u)}{\sqrt{u^2+\alpha^2}}du,\ \ w=i\sqrt{u^2+\alpha^2}+\eta_2, \tag{3}$$

where $I_0(\lambda u)-$ is the Bessel function of the first kind of zero order.

The function $\Psi(\eta,\xi)$ can be represented as

$$\Psi(\eta,\xi)=-\frac{i}{4}H_0^{(1)}(\lambda r)+\phi(\eta,\xi). \tag{4}$$

Here $-\frac{i}{4}H_0^{(1)}(\lambda r)-$ is the fundamental solution of the Helmholtz equation in R^2, defined through the Hankel function of the first kind, $\phi(\eta,\xi)-$ is the regular solution of the Helmholtz equation with respect to the variable y, including the point $\eta=\xi$.

Let $A(G)$ be a set of functions that are solutions of equation (1) in G, continuous with their first-order partial derivatives up to the boundary of ∂G (if the boundary of ∂G extends to infinity, then continuity is required only at the end points of $A(G)$).

The Cauchy problem 1. Suppose $W(\eta)\in A(G)$ and

$$W(\eta)\big|_S=f(\eta),\ \left.\frac{\partial W(\eta)}{\partial n}\right|_S=g(\eta),\ \ \eta\in S. \tag{5}$$

Here, $f(\eta)$ and $g(\eta)$ are given continuous vector-function on S.

It is required to restore the vector function $W(\eta)$ in the domain G, based on it's values $f(y)$ on S.

In the formula (3) choosing

$$\mathrm{N}(w)=\exp(\sigma w),\ \mathrm{N}(\xi_2)=\exp(\sigma\xi_2),\ \sigma>0, \tag{6}$$

we get

$$\Psi_\sigma(\eta,\xi)=-\frac{e^{-\sigma\xi_2}}{2\pi}\int_0^{\infty}\mathrm{Im}\frac{\exp(\sigma w)}{w-\xi_2}\frac{uI_0(\lambda u)}{\sqrt{u^2+\alpha^2}}du, \tag{7}$$
$$\sigma\geq\lambda+\sigma_0,\ \sigma_0>0.$$

For a function $W(\eta)\in A(G)$ and any $\xi\in G$, the following Green's integral formula holds:

$$W(\xi)=\int_{\partial G}\left[\frac{\partial W(\eta)}{\partial n}\Psi_\sigma(\eta,\xi)-f(\eta)\frac{\partial\Psi_\sigma(\eta,\xi)}{\partial n}\right]ds_\eta,\ \xi\in G, \tag{8}$$

Theorem 1. Let $W(\eta)\in C^2(G)\bigcap C^1(G)$ it satisfy the inequality

$$|W(\eta)|+\left|\frac{\partial W(\eta)}{\partial n}\right|\leq 1,\ \eta\in T. \tag{8}$$

If

$$W_\sigma(\xi)=\int_S\left[g(\eta)\Psi_\sigma(\eta,\xi)-f(\eta)\frac{\partial\Psi_\sigma(\eta,\xi)}{\partial n}\right]ds_\eta,\ \xi\in G, \tag{9}$$

then the following estimate is true

$$|W(\xi)-W_\sigma(\xi)|\leq C(\lambda,\xi)\sigma e^{-\sigma\xi_2},\ \sigma>1,\ \xi\in G. \tag{10}$$

Here and below functions bounded on compact subsets of the domain G, we denote by $C(\lambda,x)$.

Proof. We estimate the integrals $\int_a^b|\Psi_\sigma(\eta,\xi)|ds_\eta$, $\int_a^b\left|\frac{\partial\Psi_\sigma(\eta,\xi)}{\partial\eta_1}\right|ds_\eta$ and $\int_a^b\left|\frac{\partial\Psi_\sigma(\eta,\xi)}{\partial\eta_2}\right|ds_\eta$ on the part T of the plane $y_2=0$.

$$\int_a^b|\Psi_\sigma(\eta,\xi)|ds_y\leq C(\lambda,\xi)\sigma e^{-\sigma\xi_2},\ \sigma>1,\ \xi\in G. \tag{11}$$

$$\int_a^b \left| \frac{\partial \Psi_\sigma(\eta,\xi)}{\partial \eta_1} \right| ds_\eta \le C(\lambda,\xi)\sigma e^{-\sigma \xi_2}, \ \sigma > 1, \ \xi \in G. \tag{12}$$

$$\int_a^b \left| \frac{\partial \Psi_\sigma(\eta,\xi)}{\partial \eta_2} \right| ds_\eta \le C(\lambda,\xi)\sigma e^{-\sigma \xi_2}, \ \sigma > 1, \ \xi \in G. \tag{13}$$

Combining the estimates of (11), (12) and (13), we obtain the proof of the theorem.

Theorem 1 is proved.

Corollary 1. The limiting equality

$$\lim_{\sigma \to \infty} W_\sigma(\xi) = W(\xi)$$

holds uniformly on each compact set in the domain G.

Conclusion

In the work, using the Carleman function, an unknown function is restored from the Cauchy data on a part of the boundary of the region. If the Carleman function is constructed, then using Green's formula, one can find a regularized solution in an explicit form. It is shown that the efficient construction of the Carleman function is equivalent to the construction of a regularized solution of the Cauchy problem. It is assumed that a solution to the problem exists and is continuously differentiable in a closed domain with exactly given Cauchy data. For this case, an explicit formula for the continuation of the solution and its derivative is established, as well as a regularization formula for the case when, under the specified conditions, instead of the initial Cauchy data, their continuous approximations with a given error in the uniform metric are given. Stability estimates for the solution of the Cauchy problem in the classical sense are obtained.

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Preliminary data on physical and biochemical profile of loquat (*Eriobotrya japonica* Lindl.) harvested in Albania

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Cite this study: Lloha, I., Kyçyk, O., & Cara, J. (2023). Preliminary data on physical and biochemical profile of loquat (Eriobotrya japonica Lindl.) harvested in Albania. Advanced Engineering Days, 7, 106-108

Keywords
Eriobotrya japonica
Biochemical profile
Total Flavonoid content
Total phenolic content
Vitamins content

Abstract

Eriobotrya japonica is an evergreen plant that shows high medicinal value. Till now there aren't any publication in the frame of the biochemical profile of loquat that grow in Albania. Therefore, the main aim of this study was to evaluate the total mineral content (TMC), total phenolic content (TPC), total flavonoid content (TFC), tannin content, orthodiphenols content as well as total vitamin A and C of loquat fruits that grow in Albania regions. Three types of varieties of the loquat were analysed, Sayda variety, Golden Nugget variety and Nafk Cukur Gobek variety. Based on the physical parameters, it was observed that Nafik Cukur Gobek presented the highest average values in the frame of pulp weight, moisture, dry matter and other parameters. Also, the variety Nafik Cukur Gobek contained the highest values of vitamin C, vitamin A, total flavonoids and polyphenols content as well as total tannins content. The Sayda variety shows the highest acidity value. Total orthodiphenols content was determined in the Golden Nugget variety. Regardless of the data presented in this manuscript, further studies are warranted in the near future to have a full understanding of the bioactive compounds profile in loquat fruits that grow in Albania.

Introduction

The loquat (*Eriobotrya japonica* Lindl.), an evergreen subtropical fruit tree that is a member of the Rosacea family, is a native of southeast China. Nowadays this plant is cultivated in more than 30 countries around the world, including Japan, Turkey, Brazil, India, and in the Mediterranean countries, including Albania. Loquat fruits come in two primary varieties, red and white cultivars, and the color of the fruit and edible parts varies depending on the carotenoid accumulations in each [1].

Loquat as a plant shows high medicinal value. Traditionally, loquat extracts have been used for the treatment of inflammation, diabetes, and cancer [2]. Loquats are very high in antioxidants, chemicals that help protect the cells against damage and disease. In recent years, modern scientific studies, by using different experimental models have proved the anti-inflammatory capacity of different loquat tissues such as fruit [3]. Furthermore, research has shown that loquat extracts can inhibit cell carcinogenesis at several phases of the disease's evolution, including proliferation, and metastasis [4–5].

The fruit loquat is not widely cultivated in Albania. Typically, the trees are found in the yards of private houses, in villages and are completely organic. Till now there aren't any publication in the frame of the biochemical composition of loquat that grow in Albania. There are some attempts to include these fruits in different diets prescribe from nutritionist for persons that suffer from noncommunicable disease in Albania such as diabetes, obesity etc. Therefore, the main aim of this study was to evaluate the total mineral content (TMC), total phenolic content (TPC), total flavonoid content, tannin content, orthodiphenols content as well as total vitamin A and C of loquat fruits that grow in Albania regions.

Material and Method

Three types of varieties of the loquat (*Eriobotrya japonica* Lindl.) were analysed:
a) Sayda variety. Samples were harvested in Ndroq region.
b) Golden Nugget variety. Samples were harvested in Berat region.
c) Nafk Cukur Gobek variety. Samples were harvested in southern Albania region.

All the samples were harvested from April to May 2022 and during transportation, samples were kept on ice and then were stored at 4^0C at the Laboratory of Food Analyses, Faculty of Biotechnology and Food. Prior to the determination of bioactive compounds in loquat fruits, physical characteristics such as dimension, weight, color etc. were determined. The pulp and core of the loquat fruit were divided, weighed, and an average of the total weight of pulp and core were calculated. The acidity of fruit juice was determined, based on AOAC method, by simple direct titration with 0.1M sodium hydroxide, using phenolphthalein as an indicator. Total phenolic content (TPC) was calculated [6] using Folin-Ciocalteau method. The total flavonoids content was determined through the aluminum trichloride method using quercetin as a reference standard [7]. Total vitamin A determination was based on spectrophotometric methods [8]. A rapid and practical method for the total vitamin C content determination was used based on the iodine titration method.

Results

The following results belong to three varieties of loquat fruits. In "Table 1" are presented all the physical characteristic of loquat fruits such as grain weight, seed weight for which the variety of 'Nafik Cukur Gobek' presented the highest average values.

Figure 1. Measurement of physical characteristics of loquat varieties that grow in Albania

The highest mineral content, which was determined as a percentage of ash, was observed in the 'Golden Nugget' variety. From the obtained results it was observed that: cultivar 'Golden Nugget' presented higher moisture values, while cultivar 'Nafik Cukur Gobek' presented higher average values in the percentage of dry matter and cultivar "Sayda" shows the highest average value for total soluble solids (TSS).

Table 1. Physical parameters of Eriobotrya japonica varieties express as mean value

Varieties of Eriobotrya japonica	Pulp weight (g)	Core weight (g)	Moisture (%)	Dry matter (%)	TSS Brix	Ash
Sayda	22.42	15.31	87.4	13.49	11.2	0.7 %
Golden Nugget	19.96	21.62	89.5	10.36	9.1	0.6 %
Nafik Cukur Gobek	64.32	36.67	87.4	11.63	10.3	1.2 %

Table 2. Index of Loquat varieties fruits. The values of total acidity, vitamin C, vitamin A, TFC, TPC, TTC and TOC are expressed as means

Fruit index	**Sayda**	**Nafik Cukur Gobek**	**Golden Nugget**
Acidity (g/L)	0.876	0.232	0.193
Vitamin C (mg/L)	1.125	1.25	1.25
Vitamin A (μg/mol)	3.53	4.25	1.56
Total Flavonoid Content (TFC mg/L)	30.23	43.86	7.81
Total Polyphenolic Content (TPC mg/L)	349.33	434.16	219.52
Total Tannin Content (TTC mg/L)	10.17	18.90	6.71
Total Orthodiphenol Content (TOC mg/L)	52.12	22.61	59.41

Based on the study, the Sayda variety was the one with the highest acidity. Vitamin C was more present and in higher quantity in Nafik Cukur Gobek and Golden Nugget varieties. In addition to the physical parameters, it was

seen that the variety Nafik Cukur Gobek contained the highest values of total vitamin C, total vitamin A, total flavonoids contents, total polyphenols content, and total tannins content. Orthodiphenols were more present in the Golden Nugget variety. All the data extracted from the fruits of the three loquat varieties for the bioactive compound's presence, express as an average value of samples juice analyse in triplicate, are presented in Table 2.

Discussion

Due to their physical properties, such as color, texture, and flavor, as well as the significant availability of bioactive components including polyphenols, anthocyanins, and dietary fiber, consumers are seeking out and oriented toward consuming more fresh fruits and vegetables [9]. In addition to the fact that this fruit has a long heritage because its fruits have been used as treatments for diabetes, chronic lung diseases, cancer, etc., numerous scientific research on loquat are currently very encouraging in terms of the properties listed above [9]. To the best of our knowledge, this is the first report indicating the bioactive compound profile of three varieties of loquat specie that grow in Albania. The data included in this report indicate a high presence of TFC, TPC, TTC, vitamin C and A in loquat varieties. Regardless of the data presented in this manuscript, further studies are warranted in the near future to have a full understanding of the bioactive compounds profile in loquat fruits that grow in Albania.

Conclusion

The loquat cultivars we examined showed great variability in terms of their fruit commercial quality and major bioactive compound content and therefore antioxidant activities. Despite the fact that this is an ongoing study, the data presented in the manuscript show a great potential not only to include this fruit in healthy diet in the frame of preventing noncommunicable diseases but also will pave the way for additional studies to be conducted in loquat tree tissues.

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Investigation of wear of wheels and rails when the center of mass of cargo in gondola cars shifts

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Cite this study: Shvets, A., Muradian, L., & Shvets, A. (2023). Investigation of wear of wheels and rails when the center of mass of cargo in gondola cars shifts. Advanced Engineering Days, 7, 109-112

Keywords
Shift of the cargo
Railway
Gondola cars
Wear factor
Mathematical modeling

Abstract

At higher train speeds, the dynamic characteristics of the wagon are negatively affected by the uneven distribution of the mass of the body with the cargo over the springs, caused by asymmetric loading. It is well known that the safety of train traffic and the safety of transported goods depend on the method of placement and securing of goods. Determining the displacement of the center of mass of the cargo relative to the axes of symmetry of the railway car allows you to timely identify dangerous deviations in its stability and thereby significantly increase safety during the movement of the train. For stability and transportation safety, the center of mass must be at the intersection of the central longitudinal and transverse axes. A slight shift in the center of mass is possible if you need to transport non-standard cargo. Sometimes, when transporting several goods, there is a need for their asymmetrical arrangement in the wagon. Displacement of cargo relative to the center of mass of the wagon is possible during transportation. Therefore, there is a need to evaluate the effect of loading asymmetry on the dynamic characteristics of the wagon and to establish the allowable values of cargo displacement.

Introduction

New operating conditions on the railways associated with integration into the international system of transport corridors lead to the need for the development and implementation of technical progress on the main lines, the modernization of rolling stock, the improvement of transportation technology, and the increase in the speed of railway rolling stock. The increase in maximum train speeds will help speed up the delivery of passengers and goods, as well as increase the capacity of railways. Increasing the maximum allowable speeds is one of the means of raising the route speeds of trains. All this will strengthen the integration processes between countries, but this will lead to the need to control and quantify the dynamic load of the rolling stock to ensure safe and reliable communication on the railways [1-3].

Determining the permissible speeds and carrying capacity, the cost of maintaining the rolling stock and track facilities, as well as increasing the turnaround time of wagons significantly, depends on the design and technical condition of the freight rolling stock of the railways. The issue of wear and tear of rolling stock and track parts has always been of great importance for railway transport, the uninterrupted operation of which is associated with the reliability of rolling stock and track elements. The wear of the wheel flanges and the inner side surfaces of the rail heads is one of the most pressing problems for railway transport. Losses from wear of the interacting elements of wheels and rails reach significant values. An important aspect of this problem is to ensure the safety of train traffic, taking into account the wear of wheel flanges and rails. In addition, it is important that energy losses during wear increase the resistance to the movement of the rolling stock and, accordingly, the cost of energy resources [4-7].

Material and Method

The root cause of wear is force actions on the contacting bodies, which are determined by the dynamic interaction of the wheel and the rail. Therefore, an important aspect of reducing the intensity of wheel and rail wear is to reduce the dynamic loading of the interacting surfaces. When freight trains move along a track, the parameters of which are designed for the passage of high-speed passenger trains, the nature of the inscribing of freight wagon bogies into curved sections of the track inevitably changes with an increase in the angles of the running on the outer rail. This leads to an increase in lateral wear of the rails and wheels. In this direction, the condition for reducing wear is a decrease in the transverse horizontal forces of interaction between the wheel and the rail and a decrease in the angles of running of wheelsets on the rail in the curve, that is, a decrease in the values that determine the value of the wear factor [8, 9].

To assess the wear of wheels and rails, the wear factor is defined as a characteristic equal to the product of the guiding force and the angle of the wheel on the rail. Therefore, for a detailed analysis of the physical phenomena that occur when the wheel flange slides along the side edge of the rail, it is necessary to investigate the corresponding dependences of the guiding force and the angle of the running of the wheelset [4, 8].

Carrying out a preliminary assessment of the dynamic characteristics of the wagon can be achieved by using mathematical modeling. Modeling makes it possible to determine the dynamic performance of wagons when they move along straight and curved sections of the railway track with real irregularities in the vertical and horizontal planes, taking into account the real rolling surface of the wheel and the profile of the rail head [10-12].

In the study of spatial oscillations of gondola wagons, the following assumptions were introduced: it is assumed that the wagons consist of 12 solid bodies (cargo, body, two bolsters, four side frames, and four wheelsets) (Figure 1). The bogie frame scheme is supposed to be articulated. The elastic-viscous and inertial properties of the track base in the vertical and horizontal planes are taken into account.

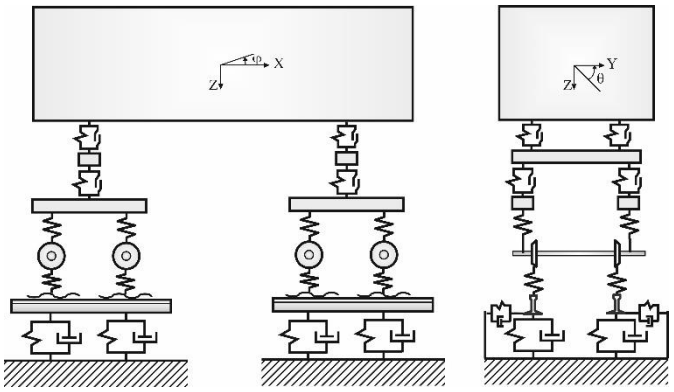

Figure 1. Calculation scheme of a 4-axle freight wagon

The center of mass of the wagon body is placed at the origin of the coordinate system, and the center of mass of the cargo is shifted by the values A_x in the longitudinal direction and A_y in the transverse direction. Taking into account the equations of relations, the differential equations of the oscillations of the wagon are compiled using the d'Alembert principle.

Results

When conducting a theoretical study, the influence of the displacement of the center of mass of the cargo in the body of a gondola wagon in the longitudinal and transverse directions, as well as in both directions at the same time, was considered. In the course of theoretical studies, taking into account the processes of oscillation of a freight wagon and cargo with displacements of the center of mass of cargo in a gondola wagon, the dependences of the wear factor were obtained taking into account the speed of movement along curved sections of the track with a radius of 350 m and 600 m with an elevation of the outer rail of 130 and 120 mm, respectively. The stationary motion was studied in order to establish the influence of only the considered factor.

The displacement of the center of mass of the load in the longitudinal direction was considered within the limits of 3 m, which is allowed according to the regulatory documents for lightweight loads. The transverse displacement of the load was considered in the range from 0 to 0.2 m. For cargo weighing 63 tons, at which the calculations were carried out, a longitudinal displacement of 0.15 m is allowed. On the route, this value can be 0.2 m. The joint displacement of the center of mass of the cargo along the transverse and longitudinal axes is considered within and from 0 to 0.15 m.

The results of analytical modeling showed that the most unfavorable option in terms of wear of wheels and rails is the transportation of light loads with a displacement of the center of mass of the load in the longitudinal direction. Graphs of changes in the wear factor, guiding force and, wheelset hunting when driving in curved sections of the track are shown in Figure 2.

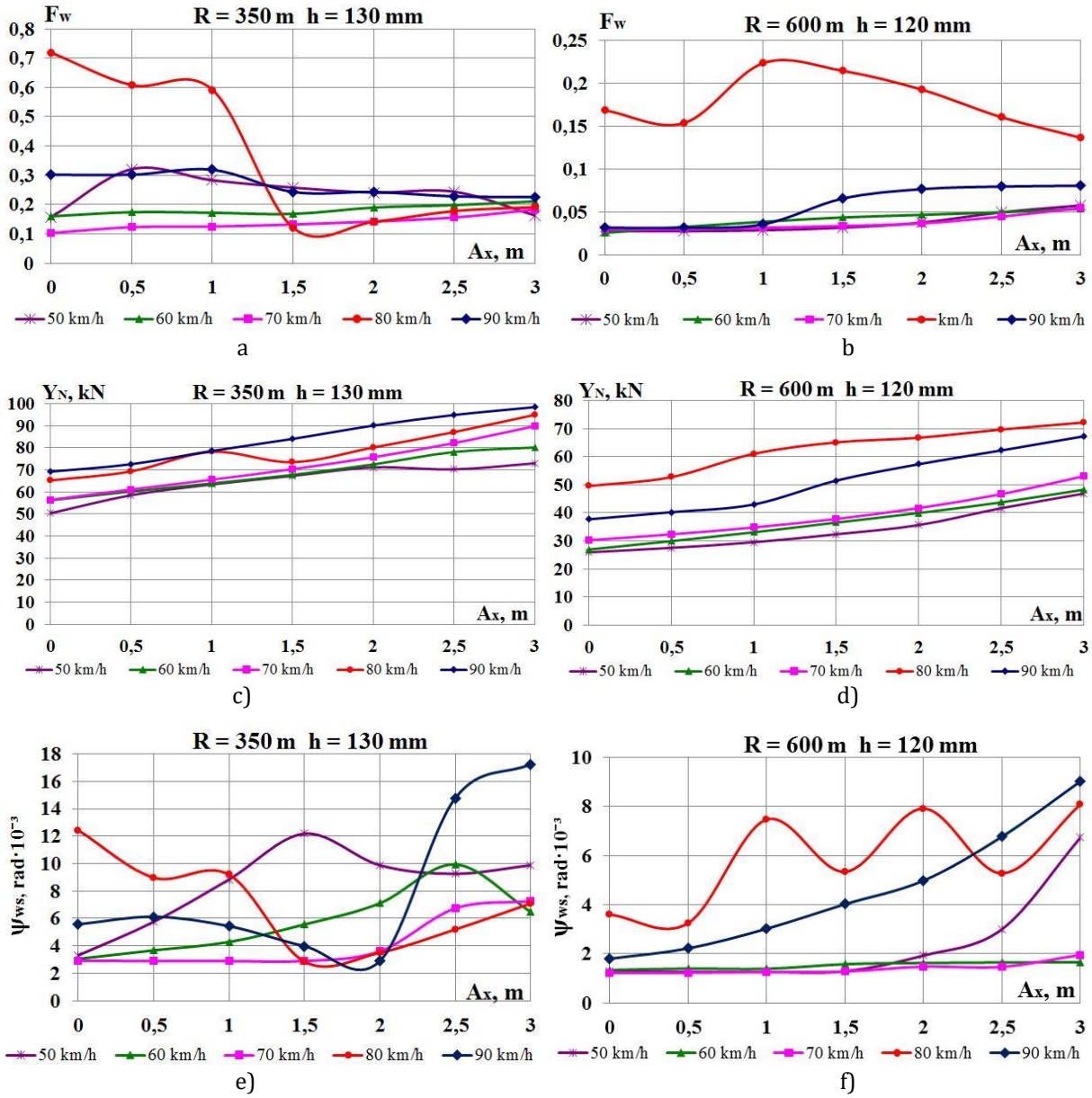

Figure 2. Dependency graphs: a, b) F_w – wear factor; c, d) Y_N – directing force acting from the side of the rail on the wheel; e, f) ψ_{ws} – wheel set hunting

As can be seen from Figure 2(a, b), in general, with an increase in the longitudinal displacement of the center of mass of the cargo, the wear factor increases, but not significantly, in the entire speed range, except for a speed of 80 km/h. The level of the wear factor in curves with a radius of 350 m is, on average, two times higher than the corresponding values in curves with a radius of 600 m. This can be explained by large levels of guiding forces Y_N (Figure 2c,d) and hunting angles ψ_{ws} (Figure 2e,f) in the 350 m curves. At a speed of 80–90 km/h, the values of ψ_{ws} with an increase in the longitudinal displacement from 0 to 3 m significantly differ from the speed range of 50–70 km/h.

The nature of the change in the hunting angles ψ_{ws} of gondola wagons on bogies of the base model 18-100 can be associated with a loss of motion stability when the dynamic transverse vibrations of the hunting of wagon parts cease to fade, acquiring a stable character (self-oscillations). Wheelsets, after the loss of stability of the movement, continuously oscillate within the track clearance, while the amplitude of self-oscillations can change within the gap in the rail track, but vibration damping is not observed. The side frames of the bogie are subjected to self-oscillations of hunting since the dynamic movements of the wheelsets occur predominantly in antiphase. The wagon body, in turn, begins to wag due to the antiphase dynamic movements of the bogies [10].

Therefore, the speed limits in curves with a radius of 350 m and 600 m must be adhered to since it is due to a sharp decrease in the safety factor from the derailment of wheels and an increase in the wear factor of the side edge of the wheel flange.

Conclusion

Ensuring the safety of train traffic requires the development of measures to reduce the intensity of wear of parts of the undercarriage of locomotives, wagons, and track elements. The study of the processes of interaction between the rolling stock and the track by experimental methods requires a lot of time and money. When considering traffic safety in extreme situations, full-scale experiments are associated with a certain risk. To reduce field studies, mathematical modeling is used to study the processes of interaction between the rolling stock and the track. Modeling makes it possible to determine the dynamic performance of wagons when they move along straight and curved sections of the railway track with real irregularities in the vertical and horizontal planes, taking into account the real wheel rolling surface and the profile of the rail head.

Based on the conducted analytical modeling, it is possible to draw the following conclusions:

- a more significant effect on the dynamic processes of the interaction is exerted by the transverse displacement of the center of mass of the cargo compared to the longitudinal displacement;
- the longitudinal displacement has a much greater effect on the guiding forces and the hunting of the wheelsets and, consequently, on the wear factor of the wheels and rails, than the transverse displacement of the center of mass of the cargo.

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Preliminary data on Albanian consumers behavior toward food consumption during the COVID-19 pandemic

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Cite this study: Berberi, E., & Shumka, S. (2023). Preliminary data on Albanian consumers behavior toward food consumption during the COVID-19 pandemic. Advanced Engineering Days, 7, 113-115

Keywords
Covid-19 pandemic
Albanian consumer
Food behavior
Online Grocery
Local food

Abstract

Albania faced the same challenges as other countries worldwide during the COVID-19 pandemic. This study evaluates how the COVID-19 pandemic has affected the food security and variety of foods available to Albanian consumers in urban areas. The research was based on a cross-sectional survey conducted between March until September 2021. Regardless of the total lockdown that characterized this period the Albanian consumers used the time of free circulation to go to markets for grocery and were oriented towards buying local products. "Ordering grocery online" 60% of the participants answered "never". This, in our opinion, is caused by a number of variables, including the brief lock down (the first period lasted from the end of March until June 2020) and consumer perceptions that eating healthily will make it easier to pass through Covid. Our findings do not allow us to predict what will happen in the long run, but risk exposure and food uncertainty have changed how consumers spend and eat. Regardless of the data presented in this manuscript, further studies are warranted in the near future to have a full understanding of the Albania consumers behavior toward food consumption especially under stressed period such as the period of COVID-19 pandemic.

Introduction

Consumer's approach to different food patterns affects the mitigation of the impact of some diseases on public health. The Covid-19 pandemic caused a number of events that changed how consumers perceived food during that time, including a shift in consumer attitudes [1]. The total lockdown at both global and regional levels to prevent the spread of infection's was one of the most dramatic occurrences that defined this time period. The result was an increase in customer insecurity toward food. Food-related habits may have been impacted by a number of psychological alterations linked to COVID-19. People were subjected to substantial communication about the COVID-19 life threat which is likely to have stressed them out. According to different publications, during lockdown, people increased their consumption of so called "comfort foods," such as chocolate, chips, and snacks due to anxiety [2].

Albania faced the same challenges as other countries worldwide during the COVID-19 pandemic. Based on the forementioned there are different reports worldwide in the frame of the consumers attitude toward nutrition, and there isn't any publication for the case of Albania consumers. This study evaluates how the COVID-19 pandemic has affected the food security and variety of foods available to Albanian consumers in urban areas. The results of this study can aid in a better understanding of the needs of the consumers during emergencies like the COVID-19 pandemic. Understanding the requirements of these populations can help in better planning and carrying out preventive interventions in a more effective way.

Material and Method

This cross-sectional research was conducted between March and September 2021 in urban areas in Albania. The design of the questionnaire used in the survey was mainly based on similar research [3] and adopted to the characteristics of Albanian consumers. The questionnaire was delivered through the online platforms, Survey

Monkey and via e-mail. The questionnaire is composed of three parts. The first part contains questions regarding demographics, including educational status. The second part contains questions regarding the consumers' behavior toward food consumption during the COVID-19 pandemic. A Liker scale was used to measure this perception, from 'never" (which has a numeric value equivalent to 1) to "always" (which has a numeric value equivalent to 5). The third part of the questionnaire contains questions if they have experienced changes in the taste of different foods during COVID-19 pandemic.

Results

The first preliminary data of the survey produced an eligible sample of 260 participants, with 65% of respondents (n = 169) residing in Tirana, 30% (n = 78) in Durres, 3% residing in Elbasan and 2% in Fier. "Figure 1" offers the summary statistics for the basic socio-demographic characteristics of the sample where more than 80% of the participants were female.

Furthermore, the participants in the survey were asked if they had experienced negative feelings during the COVID-19 pandemic such as worried, sad, nervous, or depressed. Their perception towards these feelings was assessed based on the Liker scale from "never" to "always". The majority of the participants answered "sometimes" to feeling nervous (33.33%), worried 37.50%, sad 33.33%, scared 30.77% and depressed 20.51%.

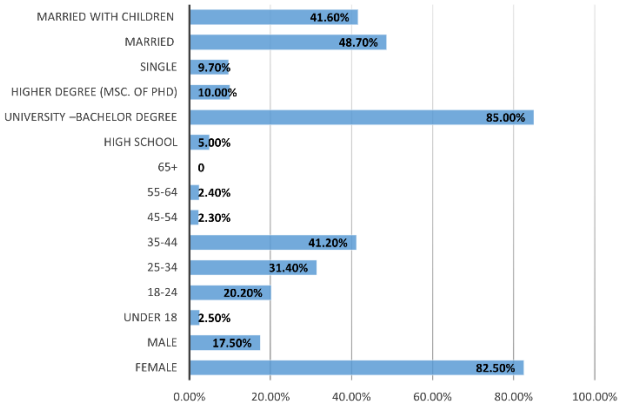

Figure 1. Socio-demographic characteristics of participants who fulfilled the questionnaire.

The second part of the questionnaire contain questions to assess the Albanian consumers in urban areas toward grocery behavior and nutrition habits during Covid-19 pandemic as shown in "Figure 2".

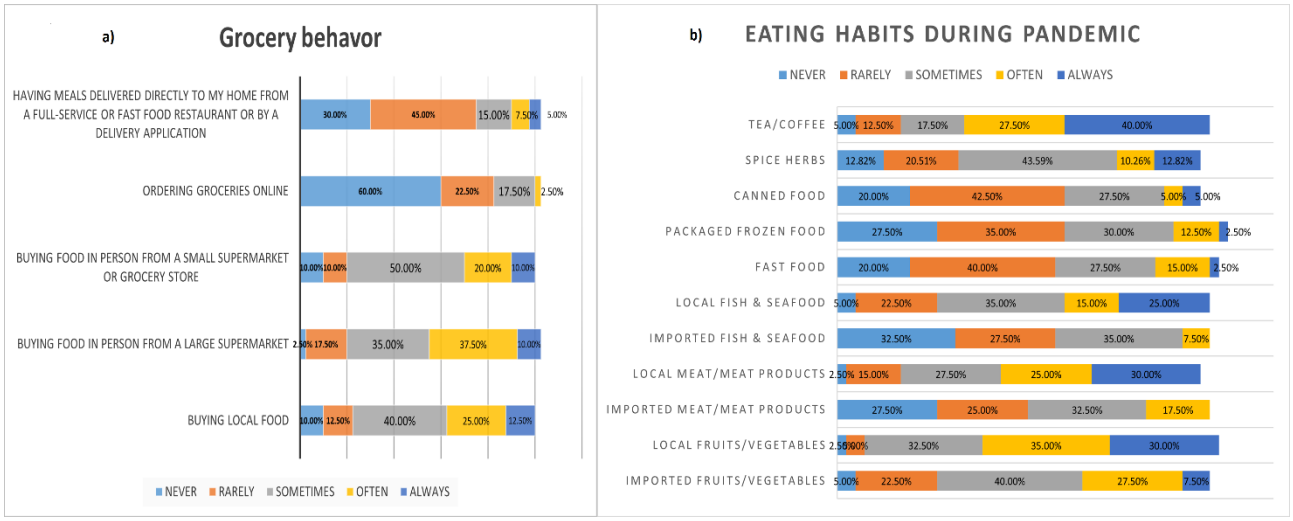

Figure 2. Consumers' behavior toward: a) grocery behavior and b) eating habits during the COVID-19 pandemic.

The preliminary data shows that regardless of the total lockdown that characterized this period the Albanian consumers used the time of free circulation to go to markets for grocery and were oriented towards buying local products. To the statement "Ordering grocery online" 60% of the participants answered "never" as shown in "Figure 2a". "Buying food in person from a small supermarket or grocery store" 20% answered "often" and 10% answered "always". 30 % of the participants choose "always" in consuming local meat/meat products and local fruits and vegetables during pandemic as depicted in "Figure 2b".

To the question "Did your taste on food change during Covid-19 pandemic?" 75 % of the participants answered "yes". Based on their perception the consumers had experiences changes in food taste mainly towards meat/meat products (30%) as shown in "Figure 3".

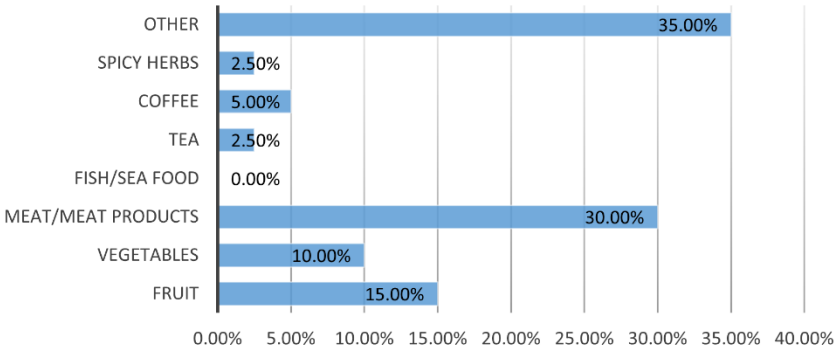

Figure 3. Consumers perception towards changes in taste of different foods during COVID-19 pandemic

Discussion

The purpose of this study was to provide information on consumer food buying habits, means of acquisition, and consumption throughout the pandemic. As with any study done at the time, the COVID-19 pandemic has affected people's consumption and buying habits [4]. For Albanian customers in the urban areas observed, these shifts weren't as significant. As a result, the majority of survey respondents continued to buy their food in small markets and tended to favor regional foods which is in compliance with some recent publications [5-6]. This, in our opinion, is caused by a number of variables, including the brief lock down (the first period lasted from the end of March until June 2020) and consumer perceptions that eating healthily will make it easier to pass through Covid. For instance, some customers might simply choose to forgo visiting the store during the pandemic in favor of continuing to shop at their favored retailer, so assuring they receive their desired goods. Our findings do not allow us to predict what will happen in the long run, but risk exposure and uncertainty have changed how consumers spend and eat.

Conclusion

The preliminary data of the cross-section survey indicate not a drastic change of Albanian consumers in some urban areas toward food consumption and acquisition during COVID-19 pandemic. Regardless of the data presented in this manuscript, further studies are warranted in the near future to have a full understanding of the Albania consumers behavior toward food consumption especially under stressed period such as the period of COVID-19 pandemic.

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The air pollution from vehicles and health risks in the city of Tirana

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Cite this study: Hajderi, A., & Bozo, L. (2023). The air pollution from vehicles and health risks in the city of Tirana. Advanced Engineering Days, 7, 116-119

Keywords
Air pollution
Human health
Pollution reduction
Risks from pollution

Abstract

In this paper, the problem of environmental pollution in urban intersections, from vehicle. The challenge today for human health remains the improvement of air quality. For this reason, the city of Tirana was studied, where the main elements of air pollution from vehicles, which are particles PM10/ PM2.5, nitrogen dioxides NO/NO_2, Benzene C_6H_6, Ozone O_3, carbon monoxide CO, were initially treated. , carbon dioxide CO_2 and sulfur dioxide SO_2, Then the effects that each pollutant causes on human health are addressed, In the following, the assessment of the health risks from the main pollutants is analyzed, where premature deaths, lost years of life and morbidity are used as indicators by the WHO, which are given for the three main pollutants, PM particles, nitrogen dioxide and ozone. For these, the WHO has determined the methodology of the impact of each pollutant, for 100,000 inhabitants. EU reports show that for 2020 in Albania premature deaths were 3600 from PM particles, 330 from nitrogen dioxides and 310 from ozone. While the lost years of life per 100,000 inhabitants were 1296 for PM, 116 for NO_2 and 115 for O_3. At the end, the ways to reduce air pollution are discussed.

Introduction

With the development of industry and the concentration of human habitation in large cities, air pollution has become a deadly threat to humans. About 7 million premature deaths are estimated from air pollution in the world every year [1].

Air pollution directly affects human health. With every breath we take, we inhale tiny particles that can damage our lungs, heart and brain, causing a host of other health problems. Most affected by air pollution are those areas, where the population density is very high, such as in big cities.

Meanwhile, in addition to premature death from air pollution, several diseases are caused to people, which make people unable to work. In 2019, in 31 European countries, exposure to NO_2 led to 175,070 years of disabled life (YLD) due to diabetes mellitus. This year, in 23 European countries, 12,253 people were hospitalized with lower respiratory tract infections and chronic pulmonary disease as a result of exposure to ozone [2].

This is why in 2021, the WHO updated its air quality guidelines by halving the previous level of 2005 norms [2]. A new OSCE report, "The Economic Consequences of Air Pollution," estimates that by 2060, air pollution will cause 6-9 million premature deaths [3].

Therefore, today's challenge for human health remains the improvement of air quality.

In our country, the city of Tirana faces the most serious air pollution in Albania, due to the heavy traffic of vehicles, the density of residential development and its geographical positioning.

The city can now be considered a problem area for a number of pollutants, but the PHI, which has the duty of health protection, does not provide regular information to the public [2].

Meanwhile, in April 2023, the media raised the problem of exceeding the pollution from nitrogen oxides and benzene in the city of Tirana above the allowed values 2-4 times and the high health risk associated with them.

Based on the above conditions and the importance of environmental pollution in human health, we undertook the study to analyze air pollution from vehicles and health risks for people in the city of Tirana.

Material and Method

The main elements of air pollution from vehicles

According to the WHO, vehicles are the biggest culprits of air pollution [1]. The main sources of air pollution come from vehicles and are [2].

Carbon monoxide (CO) is a tasteless, colorless and odorless gas. The main source is the vehicles. It arises from incomplete combustion of fuels in the engine and the highest concentrations are found near major roads and intersections.

Hydrocarbons (HC) are parts of unburned fuel (HC), which react in the presence of NOx and sunlight to form ozone (O_3) at ground level, which is a major component of smog.

Fine particles, PM2.5/ PM 10, they come mainly from cars with diesel engines. Particulate matter is the unburned carbon or soot that comes out of diesel engines.

Nitrogen oxides (NO_x) are formed from nitrogen and oxygen atoms under conditions of high pressure and temperature in the engine. It consists of nitrogen oxide and nitrogen dioxide. In the presence of sunlight, it helps in the formation of terrestrial ozone.

Benzene (C_6H_6) Benzene is an aromatic hydrocarbon. There are many sources, but the main remains the combustion of fuels from vehicles.

Carbon dioxide (CO_2) is produced by burning fossil fuels, such as coal, oil, gasoline, natural gas. The main source is vehicles, electricity production, etc. Carbon dioxide emissions contribute to climate change. Until 1995 CO_2 was considered not as a pollutant but as a perfectly burning fuel.

Ozone (O_3) is a very reactive gas that exists in the lower part of the atmosphere (ground level) but also in the troposphere. It is not directly caused by vehicles, but is formed by chemical reactions between other pollutants, initiated by strong sunlight.

Sulfur dioxide (SO_2) is a very toxic, colorless, non-flammable gas. It is formed when fuel contains sulfur.

Effects on human health

Among the effects caused to human health, according to pollutants, we have: [2, 4]:

Carbon monoxide easily combines with oxygen in red blood cells to form CO_2, preventing the supply of oxygen to the human body and brain. This paralyzes muscles and all organs and in high concentrations is extremely dangerous poison. Symptoms from CO are : mental confusion, vomiting, loss of muscle coordination, loss of consciousness. Even the doctor confuses it with a virus. Staying longer eventually results in a pleasant death.

Hydrocarbons are partially poisonous, some with the potential to cause cancer. Breathing aromatic hydrocarbons in high concentrations for long periods of time causes fatigue, headaches, dizziness and vomiting.

Fine particles cause respiratory and heart diseases, other harmful health effects and death. Long-term exposures contribute to lung cancer. According to the WHO, it is considered the most dangerous pollutant for human health.

Nitrogen oxides are active poisons, which cause irritation of the respiratory tract, when it is at a concentration greater than 150 ppm. *Nitrogen dioxide* can cause lung disease, inflammation in the respiratory tract and problems in the functioning of the lungs .

Carbon dioxide with concentration of 10% or more causes death, unconsciousness or convulsions and may harm a developing fetus. It can also cause hyperventilation, visual impairment, lung congestion, central nervous system damage, muscle contractions, high blood pressure, and shortness of breath.

Benzene increases the risk of cancer and other diseases, and is a cause of bone damage, in Albania up to 10.89 $\mu g/m^3$

Ozone in the air can harm our health, especially on hot sunny days, when it reaches unhealthy levels. Ozone irritates the eyes, nose, throat and damages the lungs. Ozone in the upper atmosphere is beneficial because it blocks harmful ultraviolet rays that contribute to skin cancer.

Sulfur dioxide causes breathing difficulties, inflammation of the respiratory tract, eye irritation, weakening of the heart. Sulfur dioxide is also linked to asthma, chronic bronchitis and death in elderly people and infants.

Health risk assessment from air pollution

Air pollution mainly affects the lungs and heart. The most common respiratory diseases are acute respiratory disease, chronic pulmonary disease, heart disease and lung cancer, which kills most people [5]. So, air pollution is the killer that freely enters the human lungs.

Chronic lung disease blocks the flow of air to the lungs and this gets worse over time. As long as the polluted air passes through the bronchial tube in the throat, it causes inflammation in the alveoli, and they stop bringing oxygen to the blood. Cancer prevention means eliminating risk factors, including air pollution [6].

Ischemic heart diseases affect the blood supply to the heart, which is the most common cause of death in many countries around the world.

To characterize the impact of air pollution on human mortality, 2 indicators are used:

*Premature deaths (*PD) are deaths that occur before a person reaches the expected age. Premature deaths are considered preventable, if their causes can be eliminated

Years of life lost (YLL) are the years of life lost due to premature deaths. It estimates the average number of years people would have lived if they had not died prematurely. This indicator for comparison between countries is used by estimating the years of life lost per 100,000 inhabitants.

In order to assess the health risk from air pollution, the WHO in 2013 defined the methodology for calculating the number of premature deaths attributable to exposure to the 3 main pollutants, fine particles, nitrogen dioxide and ozone at a certain degree of pollution [5]. For this, the methodology that shows the correlation between the degree of pollution and mortality has been built.

Also, air pollution affects the growth of many diseases in the human body, which become the reason for the creation of people's incapacity for work. This is a burden that brings personal suffering, but also significant costs for the health care sector. This is determined by the indicator of saliency**,** which represents the impacts of each pollutant in the increase of diseases that lead to the increase in the rate of disability.

Thus, morbidity expressed in years lived with disability (YLD), due to the impact of the 3 main pollutants, fine particles, nitrogen dioxide and ozone. The WHO for morbidity has defined the methodology for calculating the increase in the number of people with disabilities attributable to exposure to each pollutant at a given pollution level. This indicator is used as years of life with disability per 100,000 inhabitants [5].

Results

According to WHO, deaths related to urban air pollution are [2]:

-80% of premature deaths are from heart attacks and heart diseases,

-14% of deaths from chronic obstructive pulmonary diseases or acute pulmonary diseases,

- 6% of lung cancer deaths

In Albania, the main factors that cause respiratory diseases are carbon dioxide and benzene, which are twice the values approved by WHO [7]

The number of premature deaths in Europe from 2005 to 2020, due to the impact of O_3 Ozone above the value of 70 μg / m^3, is increasing [2].

The degree of impact of each pollutant on the human body depends not only on the amount of pollutant in the air, but also on the duration of stay in the polluted air. There is no evidence that low levels of pollution do not affect human health. So, all concentration levels are considered harmful to human health. To determine the permissible rate of a pollutant in the air, WHO has relied on studies of the impact of each pollutant, leading to a minimum of premature deaths and years of life lost. Thus, three factual concentrations were analyzed for PM 2.5 particles: 20, 10 and 0 μg/m^3, from which the rate of 5μg/m^3 was set. The same was done for other pollutants. This is the reason that the WHO changed the permissible rates in 2021, reducing the values compared to 2005 by almost half.

In Albania, according to data from INSTAT, in 2019, 21,937 people lost their lives. While in 2020 in Albania, premature deaths (PD) and years of life lost (YLL) calculated for exposure to concentrations above the norm for the 3 pollutants are given in Table 1 and 2 [5].

Table 1. Premature deaths (PD) of Albania in 2020

Average annual concentration	Premature deaths	Average annual concentration	Premature deaths	Average annual concentration	Premature deaths
15.6	3600	12.8	330	5.78	310

Table 2. Years of life lost (YLL) of Albania in 2020

Lost years of life	YLL/100,000 inhabitants	Lost years of life	YLL/100,000 inhabitants	Lost years of life	YLL/100,000 inhabitants
36,900	1,296	3,300	116	3,300	115

Conclusion

The main pollutants that affect human health in the city of Tirana are fine particles, nitrogen dioxide and ozone, which cause the main respiratory diseases up to lung cancer, cardiovascular diseases and high blood pressure. Also, dangerous pollutants are carbon monoxide, which is deadly, and carbon dioxide, which causes vision impairment, lung congestion, damage to the central nervous system, muscle contractions and high blood pressure.

In Albania, from exposure to pollution in 2020 have occurred 3,600 PD from PM particles, 330 PD from nitrogen dioxide and 310 PD from ozone. While YLL/ 100,000 inhabitants were 1296 from PM particles, 116 from nitrogen dioxide and 315 from ozone.

PM particles have the greatest impact on premature deaths, years of life lost and years of incapacity for work, followed by nitrogen dioxide and ozone. This requires the Municipality of Tirana to impose restrictions on the circulation of diesel cars in the city and GDRTS to strengthen the technical control over the level of pollution.

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Analysis of cyber-attacks through simulation

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Cite this study: Basholli, F., Hyka, D., Basholli, A., Daberdini, A., & Mema, B. (2023). Analysis of cyber-attacks through simulation. Advanced Engineering Days, 7, 120-122

Keywords
Simulation
Technology
Institutions
Cyber systems

Abstract

Nowadays, the development of information technology has brought radical changes in every aspect of people's lives and this has made our lives have a lot of access to information. Users should be very careful when using social networks, various applications and navigating the Internet world because the risk of cyber-attacks by irresponsible persons with malicious intentions is very frequent. This paper aims to provide the necessary information for cyber-attacks, where we will use for simulation tools from the MetaSploit library which is a framework that makes hacking simpler and is also an essential tool for many attackers and defender.

Introduction

Since the early days of the Internet, there have been cyber attackers with the motto "Hit and Go". Later, these attacks were aimed at modifying documents and most of them were carried out for fame and reputation, where at that time most organizations only had a firewall between the organization's network and the Internet. Today in the trend of attacks are social networks, banks, businesses, institutions and every day they are increasing, and with this development the insecurity of the users of these networks is also increasing. Now cyberattacks are modified and well-organized which are analyzed and prepared in a special way for the organization they target, modern attacks are undertaken from which hackers benefit materially or financially [1-3]. So, the best protection against Internet attacks is achieved when we understand how cyber-attacks actually work and, in the following, we will clarify the types of cyber-attacks and what we currently have available for the protection and avoidance of these attacks.

Material and Methods

The most common are Viruses, which are a piece of computer code that is attached to an application program or a file. Some viruses can cause damage, such as damage programs, delete programs, delete files and even the entire contents of the hard drive. The main goal of a cyber-attack in most cases is to steal and expose sensitive data [4]. Some of the types of cyber-attacks are:

Ransomware; "Brute-force" attack; "keylog" attack; Spear phishing; Phishing clones; Whaling; Rogue Wifi; Zero-Day Attacks.

DDoS is short for Distributed Denial of Service attacks, which occurs when a server is attacked by sending it more requests than it can respond to, causing an overload on that server that makes it impossible to respond to legitimate requests. DoS attacks are among the simplest attacks that do not aim to steal, modify or destroy information, but aim to prevent a user from using a job [5]. The method of creating a MetaSploit project. Metasploit is basically a versatile testing and penetration framework, it can perform literally all the tasks involved in a testing lifecycle. Also, since it is a complete Framework and not just an application, it can be customized and extended according to our requirements [6]. MetaSploit is used to test and analyze the vulnerabilities of computer systems for access to system control and is among the main tools of Ethical Hackers

or White Hat's or groups responsible for cyber security, not only for identifying any errors or defects. The special thing is that it allows you to be a step or two ahead of ordinary attackers.

Results and Discussions

We must note that there is no one-size-fits-all security solution, so in advance we must make a risk assessment that is preferably done by a specialized external firm and after the risk and ways of solving it have been well analyzed to decide on the best possible alternative [7].

Experimentation of DoS attacks through Simulation. The DoS attack starts when the client tries to connect to the system using the TCP protocol (HTTP or HTTPS), where it first requires handshakes to be performed before exchanging data between them. So, before we start the simulation, we identify the attacker and the victim where both use Windows operating systems and the steps we have to follow to simulate the attack are the commands after opening the MetaSploit Framework.

Now we will illustrate the steps of the simulation through figures step by step:

1-Msfconsole is the command that activates the Metasploit Framework, see Figure 1.

Figure 1. Msfconsole command view

2-In Figure 2 (second image) Metasploit is activated with 1926 exploits- 1075 auxiliary- 330 post, 556 payloads - 45 encoders- 10 nops, 7 evasion.

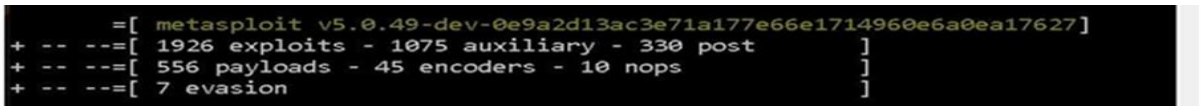

Figure 2. Metasploit view

3-Use the command "use auxilitary/dos/tcp/synflood", Figure 3 to demonstrate the DoS attack
-"set RPORT 80" sets port 80 for synflood in Metasploit

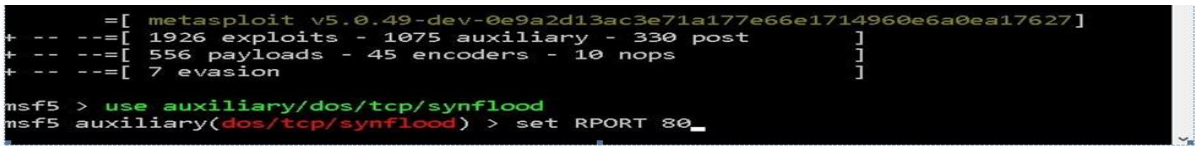

Figure 3. Metasploit view after using the "auxiliary" command

4-"set RHOST 192.168.0.29" sets the IP (Figure 4) as the destination for executing the DoS attack

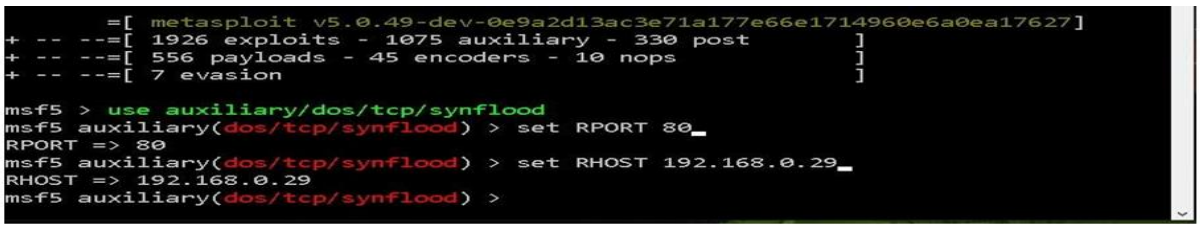

Figure 4. Results of the "auxiliary" command

5- "exploit" executes the DoS attack on the IP, the specified port (Figure 5) with the exploit provided by Metasploit. This section shows how the execution of the SYNflooding Auxiliary module is completed for the IP and port specified above.

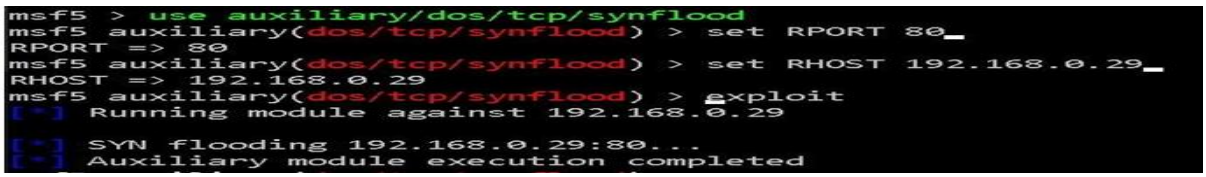

Figure 5. Execution of the "exploit"; Execution of the "Auxiliary" module of "SYNflooding"

6- "exit" command closes the processes of Metasploit Framework (Figure 6) and with this ends the simulation of DoS SYNflood cyber-attack according to Metasploit

Figure 6. Execution of the "exit" command

After the DoS SYNflood cyberattack on Metasploit towards the Windows operating system with IP Address 192.168.0.29 and with port 80, to analyze the effects of the simulation on the above-mentioned host we used WireShark software and taskmanager to see the effects caused by the simulation of demonstrated above with Metasploit. So, the administrator is able to identify the attack based on TCP Traffic which has been overloaded [8- 10]. Figure 7 shows the normal state of the CPU and RAM before the DoS TCP Syn Flood attack, as well as how the DoS attack on the CPU and RAM affects the System resources, Figure 8.

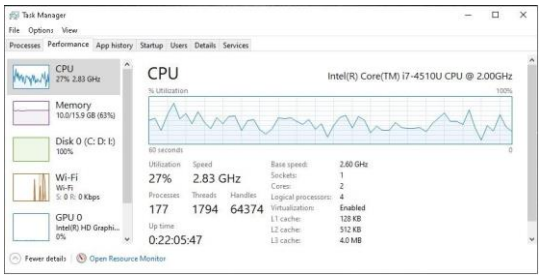

Figure 7. State of CPU and RAM before attack

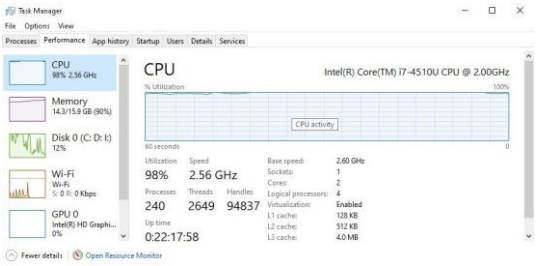

Figure 8. State of CPU and RAM after attack

From these illustrations, it was demonstrated how a TCP SYN Flood DoS cyberattack was carried out with MetaSploit, from the Windows operating system, using WireShark with filters for review and clarification.

Conclusion

Cyber-attacks include a field for which we must work and study a lot, in order to fundamentally understand the problems that this phenomenon can cause. Keep software up to date; Educate employees; Implement formal security policies; Save data (Backup); Use encryption software to protect sensitive data.

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Research on the process of obtaining pure black cumin oil

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Cite this study: Boykharayevich, F. J. (2023). Research on the process of obtaining pure black cumin oil. Advanced Engineering Days, 7, 123-124

Keywords
Black cumin seeds
Black cumin oil
Microwave processing
Drying
Oil content
Degree of extraction

Abstract

The results of studies of the effect of microwave treatment of black cumin seeds on the yield of oil, cake is presented. The significant influence of the power and duration of the radiation process on the oil production indicators is shown. Optimal technological parameters have been established, at which the degree of oil extraction is 29.60%, the cake is 70.40%. The main parameters affecting the degree of oil release are the oil content of seeds, the power of microwave radiation and the duration of the process.

Introduction

Vegetable oils have high biological value and are a source of essential polyunsaturated fatty acids, vitamins and trace elements. They are a structural part of all body tissues, favorably affect many of its systems and functions and promote proper metabolism. In this regard, vegetable oils are widely used in medicine, cosmetology, perfumery, food industry and dietary nutrition. Such a wide use of them leads to the need to obtain especially pure oils with a maximum content of biologically active substances [1-4].

In this regard, an urgent task is to develop methods for deep processing of oil-containing raw materials of the Republic to obtain environmentally friendly fat products. Deep processing implies the creation and application of new technologies that allow waste-free use of all components of raw materials and obtain environmentally friendly products [5-8].

Scientific research is being carried out to develop the oil's resistance to oxidation, study the dependence of the acid number on the duration of heat treatment, the use of ultra-high frequency electromagnetic field energy, thermal stability, the effect of essential polyunsaturated fatty acids, vitamins and trace elements on human health and the environment when used in medicine and nanotechnology [9-12].

Methods

The research was carried out using Central Asian organic Black cumin with an oil content of 35.46%. Chemical analysis of the initial, intermediate and final products was carried out by known methods [13-17].

Results and discussion

Studies of the effect of microwave radiation on weight loss, the yield of oil and cake from black cumin seeds were studied on an installation, the main node of which is a microwave oven. The radiation power varied from 100 to 300 watts at a frequency of 2450 MHz and the duration of the treatment process was 15 minutes. Studies have shown that at a radiation power of 120 watts and above, the seeds are roasted.

To establish the effect of the duration of the microwave radiation process on the yield of black cumin oil, the seeds were kept in a microwave oven at a study power of 105 watts, a frequency of 2450 MHz and a study duration of 1 to 20 minutes. The results obtained are shown in Table 1.

The table shows that with an increase in the duration of the processing of black cumin seeds for 1-5 minutes, weight loss is not observed. With an increase in the duration of the microwave radiation treatment process from 10 minutes to 20 minutes, the mass loss increases from 0.5% to 1.5%. Increasing the duration of the processing of black cumin seeds increases the oil yield from the first minutes. So, when processed for 3 minutes, the oil yield increases by 6.15% and increases from 20.97% to 27.12%. The maximum degree of oil extraction is observed

during processing for 3-5 minutes and is 27.12-29.60%. A further increase in the processing time to 20 minutes leads to a decrease in oil yield to 23.96%.

Table 1. Effect of microwave radiation on oil extraction and cake yield during pre-microwave treatment of black cumin seeds

No	Time, min	Mass Loss, %	Cake output, %	Oil output, %
1	-	-	79,03	20,97
2	1	-	73,06	26,94
3	3	-	72,88	27,12
4	5	-	70,40	29,60
5	10	0,5	73,05	26,45
6	15	1,0	73,90	25,10
7	20	1,5	74,54	23,96

Under optimal conditions of processing duration of 3-5 minutes, the yield of cake is the lowest and is 72.88-70.40%.

Conclusion

Thus, the maximum degree of oil extraction is observed during processing for 3-5 minutes and is 27.12-29.60%. A further increase in the processing time to 20 minutes leads to a decrease in oil yield to 23.96%.

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Data security in public and private administration: Challenges, trends, and effective protection in the era of digitalization

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Cite this study: Hyka, D., Hyra, A., Basholli, F., Mema, B., & Basholli, A. (2023). Data Security in Public and Private Administration: Challenges, Trends, and Effective Protection in the Era of Digitalization. Advanced Engineering Days, 7, 125-127

Keywords
Data security
Cryptography
Public administration
Private administration

Abstract

Data security is a critical concern in today's digital era, especially for public and private administrations that handle sensitive information. The growing reliance on technology and the increasing sophistication of cyber threats necessitate the adoption of robust security measures, particularly in the realm of cryptography. This research paper aims to investigate the role of cryptographic techniques in enhancing data security within the context of public and private administration. The research paper investigates the practical implementation of cryptographic techniques in administrative environments. It discusses the integration of encryption mechanisms into data storage, transmission, and access control systems. The balance between data security and privacy considerations is explored, highlighting the need for a comprehensive approach.

Introduction

Data security is of paramount importance in both public and private administration, as organizations deal with vast amounts of sensitive information. Cryptographic techniques have emerged as powerful tools for safeguarding data from unauthorized access and ensuring its confidentiality, integrity, and authenticity. This literature review aims to explore the current state of research and practices in enhancing data security in public and private administration through cryptographic techniques [1].

Material and Methods

A systematic literature search was conducted using academic databases such as IEEE Xplore, ACM Digital Library, and Scopus. Keywords used in the search included "data security," "cryptography," "public administration," "private administration," and related terms. The inclusion criteria involved selecting scholarly articles published in the last five years, focusing on the use of cryptographic techniques in data security within administrative settings. Effective key management is crucial for ensuring the secure distribution and storage of cryptographic keys. Several studies have explored key management schemes, such as Public Key Infrastructure (PKI), key exchange protocols, and key generation mechanisms. These studies focus on improving the efficiency, scalability, and resilience of key management systems in administrative environments [2].

Cryptographic techniques play a crucial role in authentication and access control mechanisms in administrative systems. Studies have investigated the use of cryptographic protocols like digital signatures, certificates, and biometrics for user authentication and secure access to resources. These techniques provide strong authentication mechanisms, ensuring that only authorized individuals can access sensitive data and perform administrative tasks. Numerous studies have examined various cryptographic algorithms and protocols applicable to data security in public and private administration. Examples include Advanced Encryption

Standard (AES), RSA, and Elliptic Curve Cryptography (ECC). Researchers have evaluated their strength, efficiency, and resistance against known attacks to identify the most suitable cryptographic techniques for different administrative contexts [3].

This literature review highlights the diverse range of research and practices in enhancing data security in public and private administration through cryptographic techniques. The findings indicate that cryptographic algorithms, key management mechanisms, data privacy techniques, authentication protocols, and blockchain technologies play crucial roles in strengthening data security. Further research is needed to address specific challenges and explore innovative cryptographic solutions tailored to the unique requirements of administrative environments [4].

Results and Discussions

Cryptographic techniques play a crucial role in authentication and access control mechanisms in administrative systems. Studies have investigated the use of cryptographic protocols like digital signatures, certificates, and biometrics for user authentication and secure access to resources. These techniques provide strong authentication mechanisms, ensuring that only authorized individuals can access sensitive data and perform administrative tasks. Protecting sensitive information and ensuring data privacy is a primary concern in administrative settings. Researchers have proposed various cryptographic techniques such as homomorphic encryption, secure multi-party computation, and zero-knowledge proofs to enable secure data sharing and processing while preserving privacy. These techniques allow administrators to perform computations on encrypted data without exposing the underlying information. Effective key management is crucial for ensuring the secure distribution and storage of cryptographic keys. Several studies have explored key management schemes, such as Public Key Infrastructure (PKI), key exchange protocols, and key generation mechanisms. These studies focus on improving the efficiency, scalability, and resilience of key management systems in administrative environments. Cryptographic operations can introduce additional processing overhead, potentially impacting system performance. Organizations need to carefully evaluate the performance impact of cryptographic techniques and optimize their implementation to minimize any negative effects on system responsiveness and throughput. Below are some questions from a survey conducted with 112 employees of public and private administration in Albania.

Among the 112 respondents from the public administration sector (Figure 1), a significant majority of 85 individuals (75.9%) revealed that they have not had the opportunity to receive any formal training on cybersecurity practices. This finding raises concerns about the level of awareness and preparedness in dealing with potential cyber threats within public administration. On the other hand, a modest proportion of 27 respondents (24.1%) reported having received some form of cybersecurity training, albeit not in the specialized domain of cryptography. This highlights a potential gap in knowledge and skills when it comes to encryption, decryption, and authentication algorithms. The lack of training in cryptography among the surveyed public administration employees suggests a missed opportunity to strengthen data security measures. Cryptographic techniques play a crucial role in enhancing the confidentiality, integrity, and authenticity of sensitive information. By equipping personnel with the necessary knowledge and skills in cryptography, organizations can fortify their defenses against data breaches and unauthorized access [5]. It is imperative for public administration entities to recognize the significance of comprehensive cybersecurity training programs that encompass not only general information security practices but also delve into the intricacies of cryptographic methods. By doing so, they can cultivate a workforce that is well-versed in the principles and applications of cryptography, thus bolstering the overall data security posture of the organization and mitigating potential risks associated with data breaches and unauthorized disclosures.

Have you received any official training on best practices in cyber security?

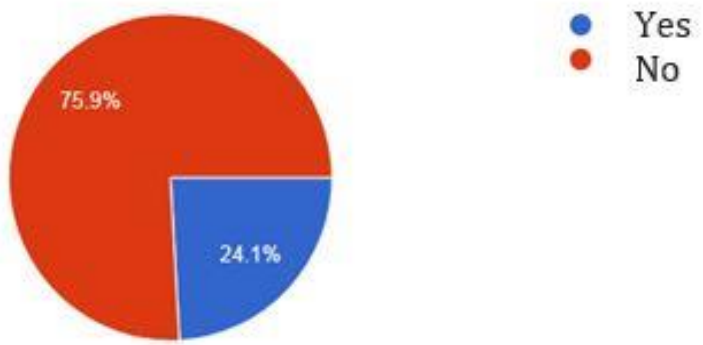

Figure 1. Staff education chart on cyber security practices

When asked about how often they have received training (Figure 2), 57.7% responded "never," 18.9% answered "rarely," indicating once or twice a year, 16.2% have received training several times within a few months' period, and only 7.2% claim to have been trained on a weekly or monthly basis. However, even these individuals who received training, it was primarily focused on cybersecurity or information security in general, risk management, network maintenance, etc., and not specifically on cryptography, data encryption or decryption, or signature and authentication algorithms.

How often do you receive updates or reminders on cybersecurity practices from your organization?

Figure 2. Chart of employee training for cyber security

Conclusion

Cryptographic techniques can be effectively employed to enhance data security in public and private administration through various means: Confidentiality, Integrity, Authentication, Key Management, Secure Communication, Compliance, etc.

To effectively employ cryptographic techniques, organizations should carefully plan their implementation, consider their specific security requirements, conduct risk assessments, and stay updated with the latest cryptographic standards and practices. Regular security audits and assessments are also essential to ensure the ongoing effectiveness of cryptographic measures in enhancing data security.

It is recommended that public administrations engage in pre-training not only in the field of information security or cyber security but also in cryptography, particularly for dedicated personnel who have a direct association with data security.

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Virtual Wheatstone bridge based on LabVIEW software for remote laboratory works

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Cite this study: Dume, G., Metalla, J. (2023). Virtual Wheatstone bridge based on LabVIEW software for remote laboratory works. Advanced Engineering Days, 7, 128-130

Keywords
Virtual Instrument
Wheatstone Bridge
LabVIEW
Laboratory work
Remote

Abstract

Nowadays, Virtual Instruments are becoming an important part of solving engineering problems in particular in the area of Automatic Control of Industrial Processes and Education. Due to the continuously increasing performance and flexibility of PC combined with their cost reduction, virtual instruments are successfully concurring the traditional instruments. During the pandemic, covid-19 as a result of adapting the emergent solution in education students and teachers should work from home. Except for lessons and seminars, doing laboratory work faced difficulties to be performed because students should be in the laboratory, which was not possible. In this work we have built a virtual instrument for electrical resistance measurement which imitates in detail the Wheatstone Bridge in our Electrical Measurement Laboratory and tested remotely to measure resistance by interacting with a virtual instrument like with the real instrument.

Introduction

Development of the technology rises the opportunities to facilitate the teaching aspect as well as the acquisition of knowledge by students. However, the speed of change in technology in various fields of science creates some problems for academic institutions, particularly engineering disciplines. This requires a constant updating and extension of teaching materials, which represents the greatest difficulty in engineering fields, where experimental support is required.

The main problem remains the same: To provide students valuable practice experience, being limited in laboratory equipment and infrastructure. One solution to this problem would be: to make use of techniques based on computers so that the students interface with the real world. This manner allows further, sophistication and flexibility because the main part of the application is created on the computer and so it can be modified without the need for additional physical devices [1-2].

From the teaching point of view, to build the applications in the laboratory, all engineering problems deal with some physical quantities such as potential difference, electric current, temperature, pressure, speed, position, mechanical torque, moisture level, etc. We can see these quantities by using a computer coupled with conditioning circuits, data acquisition, transducers, and software. Moreover, these data can be processed, and stored, and even we can publish them on the Internet. “Figure 1” illustrates an experimental test bed supported by the computer in real-time.

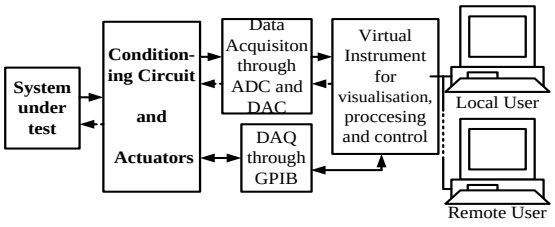

Figure 1. Block diagram of a laboratory test bench based on PC

At the Automation Department of Electrical Engineering Faculty in Tirana the Electrical Measurements subject includes 4 laboratory works. One of them deals with measuring and error calculation with the Wheatstone and Thomson Bridge.

Figure 2. MTV Thomson-Wheatstone Bridge in the Electrical Measurements Laboratory

In this work have built a virtual instrument for electrical resistance measurement which imitates in detail the Wheatstone bridge in our Electrical Measurement Laboratory "Fig. 2" and tested remotely to measure resistance by interacting with a virtual instrument like with the real instrument.

Material and Method

To build the Wheatstone Bridge Virtual Instrument we relied on [3-4] for instrument programming.

For the Wheatstone bridge formulas and theory, there is plenty of literature which can be found on the internet. However, we are referring to literature in Albanian [5] for the equation of the current flowing in the galvanometer $\mathbf{I_G}$ that is:

$$I_G = U \frac{R_1 R_4 - R_2 R_3}{R_G\left(R_1 + R_2\right)\left(R_3 + R_4\right) + R_1 R_2\left(R_3 + R_4\right) + R_3 R_4\left(R_1 + R_2\right)} \quad (1)$$

Where U- is the voltage that feeds the bridge and R_1, R_2, R_3 and R_4- are the resistors of the branches of the Wheatstone bridge.

To acquire electrical quantities in order to measure the resistance through the "**Virtual Wheatstone Bridge**" we have used the NI 6008 USB DAQ from National Instruments [6].

We measure the voltage drop and the current across the unknown resistor through two **analog inputs** of the NI 6008 DAQ card. Since this card doesn't support **analog current** inputs we used an external known resistor with a value of 1kΩ and measure the voltage drop across it. Then since analog inputs have a very high impedance we assume that the current calculation for the external resistor is equal to the current passing to the unknown resistor since the resistors are connected in series. After this, dividing the voltage across the resistor with the current calculated we obtain the resistance value in the virtual instrument.

We use the NI 6008 USB DAQ card also for feeding the interface (conditioning circuit) through one of its **analog outputs** and by changing the voltage of this output from the virtual instrument "**Sensitivity knob**" we can change the current passing through the interface and improve the sensitivity. The interface is shown in Figure 3.

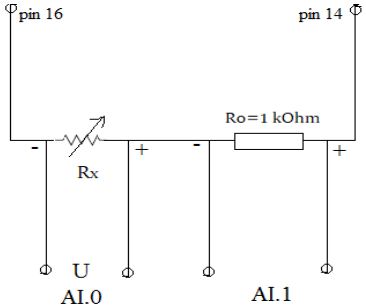

Figure 3. Interface of the virtual instrument for resistance measurement

After calculation, the unknown resistance value is not shown in the virtual instrument front panel. It is processed again by the Wheatstone bridge formula, which requires resistances R_2, R_3 and R_4 inputs calculation variables for the **galvanometer** current I_G.

R_2 is composed as the sum of 10 x (1000 +100 +10+ 1+ 0.1) Ω; R_3 and R_4 have a discrete value of (10, 100, 1000, 10000) Ω. Combining them in the Wheatstone bridge formula we get the unknown resistance value R_x when I_G=0, because R_x=R_2*R_3/R_4.

I_G current is displayed on the virtual instrument **front panel** in a "**Meter indicator"** called Galvanometri. This value is first added with a value of 0 to 1000 to imitate the series resistor R_S which is usually present in the Wheatstone bridge to limit the Galvanometer current during equilibration. Students are warned to try not to push the galvanometer indicator to the limit of its scale during interacting with the Wheatstone bridge to find the unknown resistance values.

Last, using LabVIEW G Web Server we can publish the virtual instrument online so the students can interact and perform remote laboratory work.

The Wheatstone Bridge Virtual Instrument front panel is shown in Figure 4 during R_x = 506.12 Ω value measurement (left) and its graphical code (right).

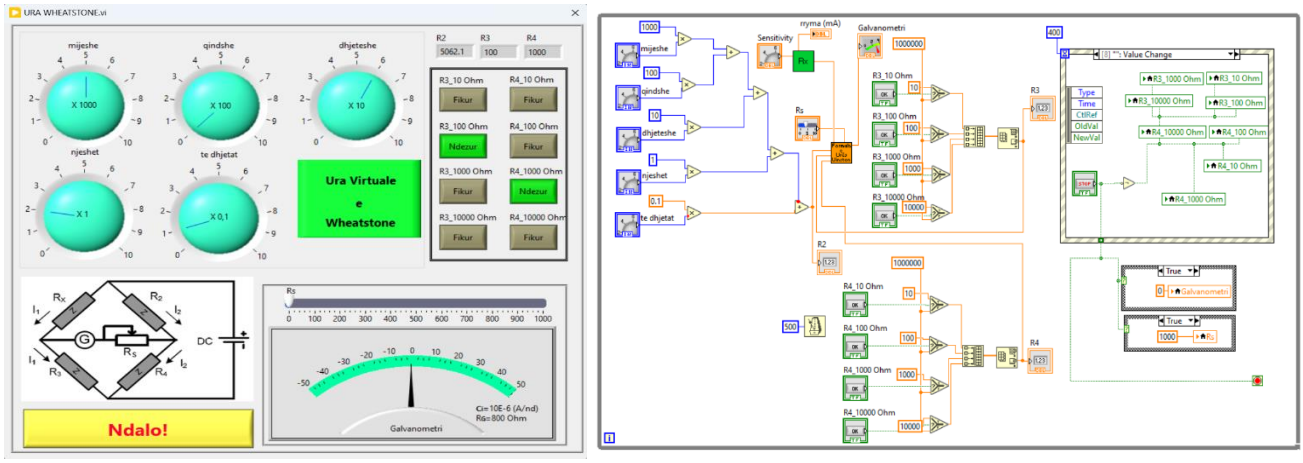

Figure 4. Virtual Wheatstone Bridge built in LabVIEW front panel (left) and its block diagram (right)

Results

Using the Wheatstone bridge virtual instrument, students at Electrical Engineering Faculty in Tirana were able to perform remote laboratory work from home in the subject 'Electrical Measurements" during the pandemic covid-19.

Discussion

This approach lacks the problem that there must be always qualified personnel in the laboratory during remote measurements to perform the changes in resistance values to be measured and to survey for any problem students may face during experimentation.

Conclusion

Using remote virtual instrumentation is very helpful when the number of students is larger than the respective laboratory can accommodate or when it is not physically possible for the student to be present in the lab.

From an educational point of view, using this approach it is possible to help some of the laboratories in the Electrical Engineering Faculties which lack the infrastructure to perform specific laboratory work so the students narrow the gap between theory and practice.

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Accounting and future challenges: Unveiling the path to financial innovation

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Cite this study: Kodra, F. (2023). Accounting and future challenges: Unveiling the path to financial innovation. Advanced Engineering Days, 7, 131-132

Keywords
Data analytics
Accounting workforce
Decision-making
Financial innovation

Abstract

Accounting is an essential function in organizations, providing critical information for decision-making, financial reporting, and compliance. However, in an ever-evolving business landscape driven by technology and globalization, accounting faces numerous challenges that demand innovative solutions. This paper aims to explore the future challenges in accounting and shed light on the transformative potential of financial innovation. By examining emerging trends such as blockchain, artificial intelligence, and data analytics, we will delve into the intriguing opportunities and complexities that lie ahead for the accounting profession. Furthermore, we will discuss the implications of these challenges and how accounting professionals can adapt and embrace change to thrive in the dynamic financial environment of the future.

Introduction

Accounting has long been the backbone of financial management, providing stakeholders with accurate and reliable information for decision-making, financial reporting, and regulatory compliance. However, the traditional practices of accounting are being disrupted by rapid technological advancements, shifting regulations, and changing business models. As organizations strive for greater efficiency, transparency, and accountability, accountants are confronted with a new set of challenges that demand innovative solutions. This paper aims to explore these challenges and shed light on the potential of financial innovation to reshape the accounting landscape.

The literature reveals a range of challenges facing the accounting profession in the future. These challenges include the increasing complexity of financial transactions, the need for real-time reporting and analysis, the demand for enhanced data security, and the changing regulatory landscape. Moreover, the emergence of technologies such as blockchain, artificial intelligence, and data analytics has the potential to revolutionize accounting practices, offering opportunities for automation, efficiency, and improved decision-making. However, these technologies also bring forth challenges related to data privacy, ethical considerations, and the need for upskilling the accounting workforce [1-5].

Material and Method

This study adopts a qualitative research approach, conducting an extensive review of relevant literature, including scholarly articles, industry reports, and professional publications. The analysis focuses on identifying and categorizing the key challenges faced by the accounting profession in the context of financial innovation. The findings provide insights into the potential impact of these challenges and the opportunities that arise from embracing innovative technologies and practices.

Results and Discussion

The discussion section explores the implications of the identified challenges and the transformative potential of financial innovation in addressing them. It highlights the role of blockchain technology in enhancing transparency and security in financial transactions, the applications of artificial intelligence in automating routine accounting tasks, and the power of data analytics in providing real-time insights for decision-making. Additionally, ethical considerations, regulatory compliance, and the importance of continuous professional development are discussed as essential components for accountants to navigate the future challenges effectively.

Conclusion

In conclusion, accounting faces numerous challenges in the face of evolving business environments and technological advancements. However, financial innovation presents exciting opportunities for accountants to embrace change, enhance efficiency, and deliver greater value to stakeholders. By understanding the future challenges and proactively embracing innovative practices, accountants can position themselves as strategic partners in driving financial success and organizational growth.

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Using RPA processes in hospital systems using artificial intelligence

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Cite this study: Qordja, G. (2023). Using RPA processes in hospital systems using artificial intelligence. Advanced Engineering Days, 7, 133-135

Keywords
E-Albania
RPA
Artificial Intelligence

Abstract

The increase in the amount of data to be processed today through hospital systems has led to the use of computer applications to accurately manage processes and decision-making. Robotic process automation (RPA), also known as software robotics, uses automation technologies to mimic back-office tasks of human workers, such as data mining, filling out forms, moving files, etc. Artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. This paper will study the aforementioned technologies to realize the process of automatic data generation for hospital systems using E-Albania. E-Albania is the government portal where the public services found in the offices and physical counters of the institutions are offered electronically thanks to the Government Interaction Platform that connects the systems of the institutions with each other. The portal is conceived as a one-stop electronic office where the citizen registers using his identity card and is served by searching and applying for the service he needs. In addition, the use of artificial intelligence in making decisions that will be taken from the data generated by the processes of automation, data generation.

Introduction

The trend of using automatic business processes has recently become a necessity. E-Albania is an instrument of a pro-informatics society built in electronic form programmed on the web. E-Albania has been developed as a multifunctional portal and is considered as a portal where citizens and businesses are provided with electronic public services. Services are available 24 hours a day, 7 days a week. The portal started as an investment of the European Union in 2009. In the initial phase, it was very simple including 6 electronic services and 4 systems connected to the government interaction platform [1].

In 2022, there are 240 institutions connected to the E-Albania governance portal. This is not just a number, but a clear indicator that reflects the usefulness of this portal, how Albanian institutions offer online services to their citizens and businesses.

Automation can run repetitive tasks. This frees up valuable time [3] for people to take on more important tasks that require judgment and rational thought. This makes the whole job more efficient and cost effective. Artificial Intelligence is designed not only to look for patterns, but also to learn from experience, so that they can choose the right answers for themselves according to situations.

The development of Artificial Intelligence is rapidly accelerating and the combination of Artificial Intelligence with automated robotic processes is beginning to change the way businesses are operating [2]. Artificial intelligence is widely used in various industries and business fields, ranging from healthcare, finance, manufacturing to law, education, etc. With the help of machine learning, doctors can diagnose diseases faster than before [2].

Van der Aalst et al. [4] describes RPA as a tool that operates on applications installed on computer systems through a graphical user interface, as a human would.

RPA is not a physical machine, but a software system that automatically communicates with other digital systems, sends and receives data, manipulates them and inserts them into other applications [4].

Material and Method

There are many functionalities of online government services in Albania. Figure 1 shows a general view of the national interface of Albania, where, in addition to the civil services that are fully operational, there are functions related to health [9].

In this interface, all the information of the registration of reports of the citizens of the Republic of Albania is connected through Albania, where in real time the report is generated by the doctor and goes automatically to the work center. As the reports are generated, there are other functionalities related to the application for drugs subsidized by the Albanian state.

The complexity and growth of data in healthcare means that artificial intelligence (AI) will be increasingly used within the field. Machine learning is a statistical technique for fitting models to data and 'learning' by training models with data. The study was conducted in 4 hospitals in Riyadh, the capital of Saudi Arabia. The results were related to the fear of job replacement by AI and the school of knowledge about AI technology. Results of the study needed for training on the advantages, challenges and issues related to me and AI in possible care and the potential of technology to have a professional care process and efficiency.

The training would expand the knowledge of AI workers and improve their potential for the care of his sector in their care. Governments and universities can play an important role in advancing the care of research using AI technology.

Furthermore, the current status of AI use in healthcare in Saudi Arabia provides a clear market for AI solution developers [6].

In healthcare, the most common application of traditional machine learning is precision medicine that predicts which treatment protocols are likely to succeed in a patient based on various patient attributes and treatment context. This field, NLP, includes applications such as speech recognition, text analysis, translation, and other language-related purposes. There are two basic approaches to it: statistical and semantic NLP. Statistical NLP is based on machine learning (in particular deep learning neural networks) and has contributed to an increase in the accuracy of recent recognition. It requires a large "corpus" or body of language from which to learn. Compared to other forms of AI, they are cheap, easy to program, and transparent in their actions. Robotic process automation (RPA) doesn't really involve robots - just software on servers [5]. A recent development in the field of process mining is that performance and compliance issues automatically trigger remedial workflows leveraging both data and existing systems [5]. AI and Robotics are being used at many points of service for COVID-19 to a significant extent. For the detection and diagnosis of COVID-19, newly discovered AI-driven methods have helped to reduce the pressure on conventional methods [8].

Figure 1. Main interface of e-Albania

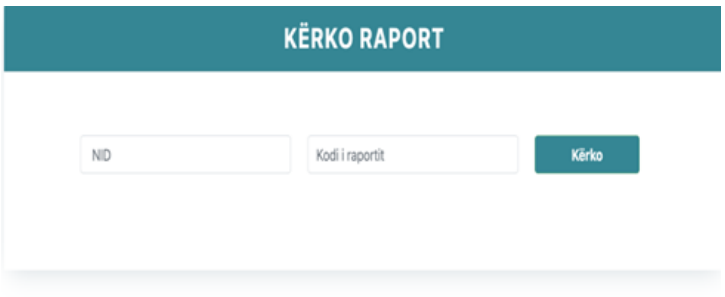

Figure 2. Report generation interface

Figure 3. Report generation interface

Conclusion

1. The connection of Hospital Systems, clinics in Albania helps in the management of drugs through pharmacies.
2. The use of artificial intelligence inserted as functionality in Robotic Business Processes ensures automatic decision-making in data management.
3. The implementation of RPA and Artificial Intelligence in E-Albania increases the quality of service in the Hospital system.

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Assessing Albanian consumer's perception of safety towards animal food products: Preliminary data from a cross-sectional survey

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Cite this study: Lloha, I., & Berberi, E. (2023). Assessing Albanian consumer's perception of safety towards animal food products: Preliminary data from a cross-sectional survey. Advanced Engineering Days, 7, 136-138

Keywords
Food safety
Consumers perception
Antibiotics
Hormones
Technological treatments

Abstract

Food safety is a major concern for Albanian consumers. Just like consumers in the EU countries, Albanian consumers share the same concerns about food safety. Therefore, the first aim of this research is to assess the perceived safety of Albanian consumers of three different product categories with animal origin (milk/milk products, eggs and meat/meat products). The second aim is to explore the relationship between the safety perception from the consumers and different technological treatments applied in these products. In the manuscript are depicted the first preliminary data collected from November 2022 to April 2023 from a cross-sectional survey. From a panel of potential hazards in food, antibiotics and hormones were perceived by the Albanian consumers as the main hazard in three types of foods taken under consideration. In the frame of technological treatments of food and its impact in the safety of food, the data shows that raw milk, fresh eggs, and meat directly from the butcher were perceived as “Safe” or “Totally safe” from Albania consumers. Despite the fact that this is an ongoing study we believe that other qualitative research in this direction is mandatory in the near future in order to have a more complete view of Albanian consumers on this topic.

Introduction

The concept of “Food Safety” is in correlation with consumer’s health which is related not only to microbiological hazards but also to misuse of food additives, chemical contaminants, including biological toxins, and adulteration [1]. These factors may change from one research to another because of the consumer profile taken into examination [2-3-4]. The globalization of the food chain, so called "From farm to table", makes the traceability exceedingly challenging and, on the other hand, has raised consumer concerns about both the quality and safety of their food. Just like consumers in the EU countries, Albanian consumers share the same concerns about food safety. Therefore, the first aim of this research is to assess the perceived safety of Albanian consumers of three different product categories with animal origin (milk/milk products, eggs and meat/meat products). The second aim is to explore the relationship between the safety perception from the consumers and different technological treatments applied in these products. We are presented in this manuscript the first preliminary data of an ongoing study.

Material and Method

The research is a cross-sectional survey. The questionnaire was delivered in November 2022 through online platforms (google form) and is still ongoing. The design of the questionnaire used in the survey was mainly based on similar research [2] and adopted to the characteristics of Albanian consumers. The questionnaire is composed of three parts. The first part contains questions regarding demographics characteristics, including the frequency of the frequency of the consumption of three different product categories (milk, eggs and meat). The second part contains questions regarding the consumers’ perception toward the main hazards of these three categories of foods. In the third part a Likert scale was used to explore the relationship between the safety perception from the consumers and different technological treatments applied in these products. The Likert scale used varies from

"*Totally unsafe*" (which has a numeric value equivalent to 1) to "*Totally safe*" (which has a numeric value equivalent to 5).

Results

The first preliminary data of the survey, from November 2022 until April 2023, produced an eligible sample of 356 participants. All the demographic characteristics of the participants are as depicted in Table 1.

Table 1. Demographic characteristic of the participants until April 2023 expressed as frequency (n) and rel. frequency (%)

Variables	Categories	Frequency (n)	Rel. frequency (%)
Sex	male	151	42.4
	female	205	57.6
Age	18-30	43	12.1
	31-50	246	69.1
	more than 50	67	18.8
residence	village	37	10.4
	town	319	89.6
household composition	single	68	19.1
	married	81	22.8
	married with children	207	58.1
Frequency of milk consumption	Daily	231	64.9
	Minimum 1 per week	91	25.6
	Minimum 1 per month	28	7.9
	Less than 1 per month	6	1.6
Frequency of milk product consumption	Daily	253	71.1
	Minimum 1 per week	47	13.2
	Minimum 1 per month	31	8.7
	Less than 1 per month	25	7
Frequency of egg consumption	Daily	241	67.7
	Minimum 1 per week	87	24.4
	Minimum 1 per month	22	6.2
	Less than 1 per month	6	1.7
Frequency of meat consumption	Daily	101	28.4
	Minimum 1 per week	223	62.6
	Minimum 1 per month	25	7
	Less than 1 per month	7	2
Frequency of meat product consumption	Daily	67	18.8
	Minimum 1 per week	245	68.8
	Minimum 1 per month	36	10.1
	Less than 1 per month	8	2.2

In the second part of the questionnaire, it was assessed the perception of the participants toward the main hazards in milk, eggs, and meat. In the questionnaire it was obligatory to choose only one of the hazards from the list. Antibiotics and hormones were perceived by the consumers as the main hazard in three types of foods taken under consideration as depicted in Figure 1.

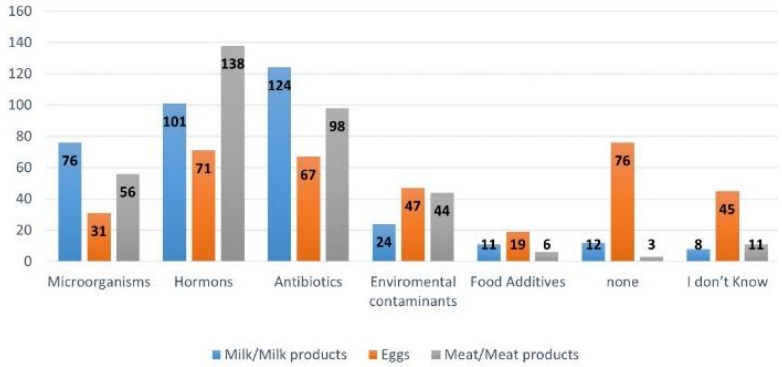

Figure 1. Perception of Albania consumers towards the main hazards in milk, eggs and meat expressed as frequency (n)

Furthermore, we assess if there is a relationship between food origin and safety perception of the consumers. Among different variables (*Local/Albanian food products; Regional/Balkan Food products, Mediterranean food products; Other EU food products and Outside EU Products*) the participants must choose only one option, the one that they perceive more safety. The first preliminary data show "Local/Albanian food products" and "Mediterranean food products" were perceived as more safety compared to other categories, respectively 43% and 39%. In the third part of the questionnaire, it was assessed the effect of food technology on the perceived safety of different products. The participant must choose only one of the following, from "*Totally unsafe*" to "*Totally safe*", versus different types of food categories. The first preliminary data shows that raw milk, fresh eggs, and meat directly from the butcher were perceived as "*Safe*" or "*Totally safe*" from Albania consumers as depicted in Fig.2a, Fig 2b and Fig 2c. We believe that there is misleading information among consumers that quality food is always a safety food (this part of the questionnaire is still under processing).

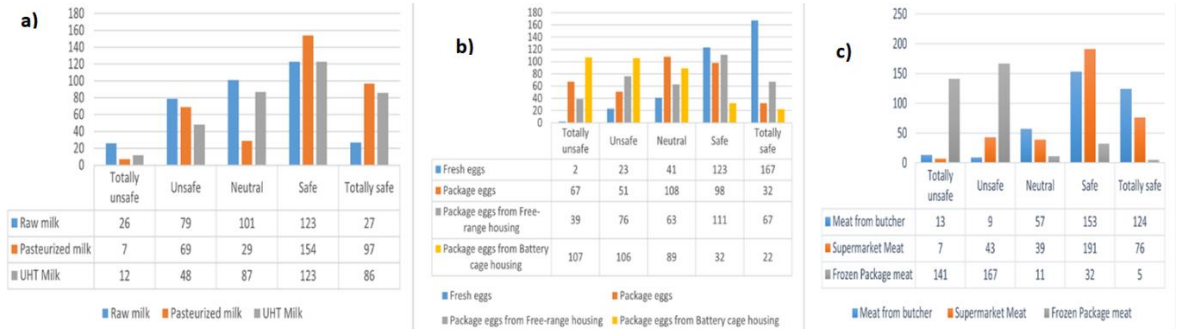

Figure 2. Albania consumers safety perception towards foods and different technological treatments applied in a) milk, b) eggs and c) meat

Discussion

There have been some attempts at assessing consumer perceptions of the safety of food products in Albania [4-5], but public understanding of the idea of food safety is still insufficient, particularly in connection to how consumers view food technology [2]. Our data indicates that the most important hazards in three categories of food taken under consideration (milk, eggs and meat) according to the Albanian consumers are antibiotics and hormones. Milk and meat products had similar patterns of chosen hazards from the consumers which follows the literature [2, 6]. We believe that other qualitative research in this direction is mandatory in order to have a more complete view of Albanian consumers on this topic. Moreover, these types of research will shed light on the difference between what consumers claim to be of concern and what may actually be problematic for food safety.

Conclusion

The first preliminary date extracted from the questionnaire highlighted antibiotics and hormones as the main hazards in three different categories of food products (milk, eggs, and meat) and moreover technological treatments applied in milk/milk products are not perceive as negative factors that will affect the safety of this product according to Albanian consumers.

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Internet of things in the development of future businesses in Albania

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Cite this study: Mema, B., Basholli, F., Xhafaj, D., Basholli, A., & Hyka, D. (2023). Internet of things in the development of future businesses in Albania. Advanced Engineering Days, 7, 139-141

Keywords
IoT
Business
Network
Technology

Abstract

Internet of Things (IoT) refers to a technology that connects various devices and objects, leading to a digital revolution in different aspects of life. It has the potential to create highly efficient and rewarding smart environments for individuals. The IoT not only impacts our daily lives but also significantly influences how we work and conduct business. This article focuses on IoT technology and how it affects businesses, emphasizing how crucial it is for such organizations to be ready for and able to adapt to the changes it brings. Let's see if SMEs (Small and Medium Enterprises) in Albania can benefit from the further advancement of IoT (Internet of Things), what are the expectations, possibilities, and potential risks that may arise on this journey.

Introduction

This work aims to study Internet of Things (IoT) and explain their importance, especially in the field of economic development and their increasing significance in the coming years and decades, as well as the crucial role they will play in the development of future businesses. Due to the fact that the future of many businesses will depend on their relationship with AI and IoT, their investments in the development of these technologies, and their undeniable importance, these were the main areas for choosing these two areas of study. With this research, I intend to explore how these technologies can assist businesses, companies, and various institutions in developing their products, services, and operations. The purpose is to understand the potential opportunities and challenges related to their implementation and to comprehend the general concerns of employees and policymakers regarding these advancements [1]. Businesses have always tried to find practical and intelligent ways to reach consumers or service seekers, adapting their products and services to the market's demands and current trends. This work aims to explain the new and latest approaches to this issue, to present the current and potential future scenarios, and to demonstrate how the use of Artificial Intelligence and the integration of the Internet of Things can support and facilitate such endeavors [2]. The methodology used in the analysis and research is primarily qualitative, based on theoretical foundations, considering concrete information derived from researchers and official economic publications related to AI and IoT. However, this research also includes quantitative methodology with practical, numerical, comparative data, as well as information obtained from surveys [3].

Material and Methods

This work aimed to analyse the economic impact of Artificial Intelligence (AI) and the Internet of Things (IoT) on existing businesses and their potential influence in the future, including not only the businesses currently operating and utilizing AI and IoT systems but also future businesses aiming to incorporate AI and IoT into their

operational processes. Regarding the methodology used throughout the analysis and research, it primarily relied on qualitative methods based on theory, taking into account specific information derived from researchers, theorists, as well as official economic publications [4]. However, this research also included quantitative methodology with practical, numerical, comparative data, and information obtained from a questionnaire sent to a narrow group of professional employees. It was necessary to analyse market demands, applicability, acceptability, and the potential positive or negative impact that the implementation of these systems could have, as well as potential risks that may arise during and after implementation. This analysis involved examining how major economies respond to the newly created situation due to significant advancements in AI and IoT, how they plan to invest in these innovations, aiming for further economic development. In addition to theoretical studies, this research also relied on concrete case studies, including the analysis of numerical data and predictions derived from analyses of the past 3 to 5 years, all related to these systems and their potential impact on the economy in the future. This demonstrates the combined nature of the research, incorporating both qualitative and direct quantitative methods. The survey was conducted using a questionnaire prepared through Google Forms. This online survey format was confidential to ensure efficiency and active participation of respondents. The survey was divided into four parts or sections. The first section consisted of eight personal questions to gather data about the respondents, which will be further explained in this chapter. The remaining three sections were divided into groups of questions regarding IoT. In total, there were 10 questions with four optional answers to provide a clear indication and facilitate data processing [5-6]. This allowed for the extraction of stable, independent, and highly reliable results, with an exceptionally high response rate compared to the initial number of individuals, businesses, and institutions that were invited to participate in the survey.

Results and Discussions

Information has been requested through the questionnaire regarding respondents' knowledge about usability of AI in the companies or institutions they work for. A slightly smaller number of them have real knowledge about the elements that enable the functioning of IoT. An equal number of them believe that IoT will help in the development of their businesses, while a significant portion of them is unsure.

Similarly, those who believe that it will be necessary to use IoT in their businesses in the future share almost the same opinion. Interestingly, the majority of the respondents think that IoT will create new circumstances for business and entrepreneurship that they haven't considered before, with 26.3% being unsure or unaware, and none denying it. The final set of questions aimed to summarize the general knowledge about IoT development, the influence of these digital technologies on their organizations, adaptation to potential new circumstances, innovation, new services, as well as the possibility of job risks [7-8]. The answers are as follows:

There is a genuine skepticism among the respondents regarding how well employees can adapt to new technologies as a result of IoT development. More than half are uncertain or unaware, while 47.4% are positive and claim that adaptability is possible. A large number of them believe that new digital technologies will enable new developments in their businesses. A relatively large number of respondents declare that with the application of technologies like IoT, they can innovate their products and services. 71.1% affirm this, while only 5.3% deny it. The last two questions are very specific and aim to gather responses regarding the perception of how current jobs could be endangered or threatened by technologies like IoT, with a significant number believing that they could, and 18.4% who do not believe that jobs will be threatened by this factor. Furthermore, in the question about the potential replacement of a large portion of current jobs with further development of AI and IoT, we obtain similar results, indicating a potential fear of job loss [9]. Variable testing was conducted using the statistical program SPSS. Comparisons were made between the questions extracted from the questionnaire and the hypotheses, resulting in an analysis of correlations between the independent hypotheses and IoT in relation to business development as the dependent variable, Table 1.

Table 1. Correlations between Business Development and Internet of Things

		ZhiB	IoT
ZhiB	Pearson Correlation	1	.654**
	Sig.(2-tailed)		.000
	N	38	38
IoT	Pearson Correlation	.654**	1
	Sig. (2-tailed)	.000	
	N	38	38

"Descriptive statistics" presents the collected information in a suitable, usable, and understandable form. After gathering the data, descriptive statistics allow us to calculate their frequency, measures of central tendency (such as mean, median, mode), etc., and identify the characteristics in the distribution of results. Table 2 describes the standard deviation from the average of the responses extracted from the questionnaire for specific

variables. For the Business Development variable, the deviation from the mean is 1.13, with an average of 1.982. This means that there is a deviation of ±1.13 from the mean of 1.982. For the Internet of Things variables, there is a deviation of ±1.74 from the mean of 2.386.

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
ZhiB	38	1.00	6.00	1.9825	1.13091
IoT	38	1.00	6.00	2.3860	1.74419
Valid N (listwise)	38				

As for the presented hypotheses, the following results were obtained from the respondents' answers:

The respondents confirm the importance of digital technologies in the growth and development of businesses, with percentages ranging from 57.9% to 73.7%, depending on the nature of the question. It is rejected because 63.2% express familiarity with Internet of Things technology, with 57.9% of them stating that they have knowledge of device connectivity in such a system. Difficult, with half of them being uncertain or unaware, and only 2.6% denying it. Additionally, 63.2% to 68.4% believe that their jobs will be threatened by these technologies [10-12].

Conclusion

The development of AI and therefore IoT is still in its early stages, we must follow these trends because future employees must have basic knowledge of digital technologies, especially Artificial Intelligence and the Internet of Things. Young people need to understand the importance these technologies will have in their lives and work so that they can easily adapt when the time comes for implementation. Special subjects should be created in the curricula to inform students about the latest achievements in AI and IoT.

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Radar protection system against anti-radar missiles with integrated detection channel

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Cite this study: Khmarskiy, P. A., Muxammedov, B. M., & Juraev, D. A. (2023). Radar protection system against anti-radar missiles with integrated detection channel. Advanced Engineering Days, 7, 142-144

Keywords
Anti-radiation missile
Object detection
Radar tracking
Radar signal processing

Abstract

Developed and justified the appearance of the system of protection of radar observation station from anti-radar missiles. In order to detect homing high-precision weapons, it was proposed to include in the radar a channel for detecting signs of the trajectory of an anti-radar missile, taking into account its distinctive features.

Introduction

In air defense systems, modern surveillance radar stations (radars) are the most important sources of information about the air environment. According to their purpose, the surveillance radars are the first to come into contact with the air enemy, and at present, due to the rapid development of high-precision weapons, radars have become priority targets for destruction [1-6]. A particular threat to surveillance radars are such high-precision weapons as anti-radiation missiles (ARM).

a *b*

Figure 1. Examples of radar fire: a) destroyed radar equipment during the armed conflicts in Nagorno-Karabakh; b) in Ukraine

Timely detection of anti-radar missiles contributes to an increase in missile homing missiles on the radar (due to the implementation of special measures) and leads to an increase in the probability of radar protection from missiles. However, detection of anti-radar missiles is complicated by the fact that it is conducted in a complex signal-interference environment with a low signal-to-interference ratio, which necessitates adaptation and correction of algorithms for primary and secondary radar information processing. Thus, the selection of anti-radar

missiles is not possible in a single contact (review) and requires the use of algorithms for combining multiscan information - i.e., multiscan selection of moving targets.

Material and Method

At the moment the following systems of multiscan selection of anti-radar missiles are known [1-5]: according to external targeting data and with the detection channel built into the radar, which have high enough efficiency and at the same time serious drawbacks: low mobility, high cost of production and operation, low probability of correct detection.

A distinctive feature of the first selection systems is the coupling with the external radar detector, which detects dangerous (similar to anti-radar missiles) targets flying at the radar, determines their speed and time of approach [1]. Such systems have a sufficiently high efficiency, but their use leads to deterioration of radar mobility, reliability of its operation and increase the cost of production and operation. Therefore, as an alternative, some radars use built-in anti-radar missile detection channel.

When building a defense system, one should also keep in mind the promising, priority directions of development of counter radar missiles [1-5]: increasing the launch range by using more efficient fuel mixtures, reducing the weight of the ramjet and using direct-flow air-jet engines; expanding the operating frequency range of the passive radar homing head from 0.5 to 40 GHz, increasing the sensitivity and immunity of the homing head receiver; equipping the anti-radar missiles with a combined guidance system that includes an autonomous inertial navigation system, corrected via a GPS receiver, and one of the homing systems at the end of the anti-radar missile's flight path: passive radar, active radar, or passive optoelectronic; redirection of anti-radar missiles in flight to another radar; targeting of anti-radar missiles to mobile radars, including when they are moving by using the proportional guidance method; eliminating the danger of hitting their radar. The key features of the ARMs as radar observation objects are as follows: launch range of 100 to 180 km; average flight speed of 660 to 1200 m/s; effective scattering surface (in cm-dm ranges) of 0.06 to 0.2 m^2 [1].

Results and Discussion

Taking into account the advantages and disadvantages of the existing defense systems, the design of an advanced comprehensive system of radar protection from high-precision weapons was developed (Figure 2). This defense system is based on methods that help reduce information about the homing object (radar), as well as shifting the point of aim of the missile defense from the location of the radar.

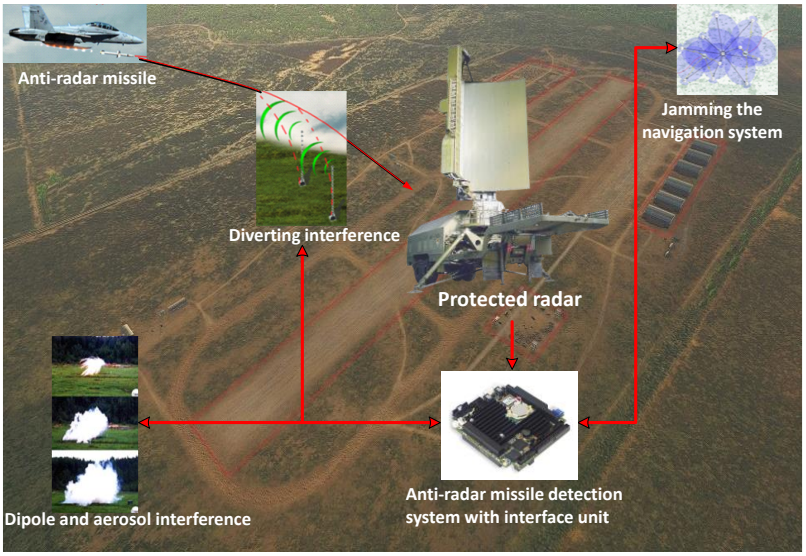

Figure 2. Integrated system of radar protection against anti-radar missiles

The radar protection system includes: control unit (interface); set of diversion devices (radar and infrared emitters); set of launchers for dipole and aerosol interference; set of cables; system of detection of SRBs; built-in channel for detection of anti-radar missiles. Diversion devices are a diversion chain consisting of additional radio emission sources. The main purpose of creating such a chain is to divert a booster away from the radar by successive activation of additional radiation sources. Dipole deflector launchers create passive interference for the radar homing head, contributing to premature triggering of the fuse and detonation of the warhead long before it reaches the radar. Aerosol jamming launchers reduce the transparency of the atmosphere in the optical and radio bands, provide absorption of radio waves and increase radar stealth.

A number of additional special technical measures have been adopted in the counter radar missile detection channel [7-10]: adaptive inter-period accumulation, an adaptive decision-making device with a reduced detection threshold, a one-time estimation device, and a trajectory processing device implemented according to the TBD (Track-before-detect). These approaches together will provide the necessary probability of detection of a ballistic missile (usually selected at least 0.5) over virtually the entire range of its flight to timely activate sets of diversion devices (radar and infrared emitters) and launchers for dipole and aerosol interference.

In the proposed trajectory-processing device of the radar defense system, the central place is taken by the dangerous trajectory detector, a DRD aimed at the radar. For its operation it uses the a priori information about the possible ranges of parameters of known SLBMs (HARM (USA), Martel (France), Tacit Rainbow (USA), ALARM (UK), Delilah (Israel), etc.): launch range, flight speed, effective dispersion area value. These parameters are evaluated, after which a probabilistic decision on the detection of a dangerous trajectory is made based on the obtained trajectory and signal indications, which is given to the operator, who, based on the emerging situation, activates protective means and changes the operation modes of the radar.

Conclusion

The appearance of complex system of radar protection from high-precision weapons on the example of the dispatcher radar, which is part of the system of radio technical support of aviation flights is proposed. The key difference of the proposed solution is the refusal of an external missile detector in favor of an additional channel of processing and separation of the missile radar, working on the received signal of the radar. This allows to reduce the cost of the specified protection system and is possible due to the high energy potential of the protected dispatcher radar. In addition, in the specified channel it is proposed to take a number of special technical measures to improve the efficiency of detection and tracking objects with a small value of the effective scattering surface: adaptive accumulation and decision-making with a reduced detection threshold and trajectory processing device.

Research was carried out with the support of a grant from the Belarusian Republican Foundation for Basic Research (Project No. T22UZB-009) and the Ministry of Innovative Development of the Republic of Uzbekistan (Project No. IL-4821091588).

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The implementation of Latent Dirichlet Allocation (LDA) model on IEEE Xplore dataset to find the impact of artificial intelligence in education sector

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Cite this study: Idrizi, O., Harizaj, A. &, Harizaj, M. (2023). The implementation of Latent Dirichlet Allocation (LDA) model on IEEE Xplore dataset to find the impact of artificial intelligence in education sector. Advanced Engineering Days, 7, 145-147

Keywords
Latent Dirichlet Allocation
LDA
Artificial Intelligence
Education Sector
Machine Learning

Abstract

The field of education holds immense significance, calling for a reevaluation of learning methods and approaches. Particularly in recent years, there has been a growing inclination within higher education to incorporate emerging technologies and artificial intelligence (AI) in order to enrich the learning process. This study aims to analyze the Latent Dirichlet Allocation LDA, as a probabilistic Bayesian model designed for analyzing collections of discrete data, such as text corpora. LDA employs a three-level hierarchical Bayesian model, where each item in the collection is represented as a finite mixture derived from a set of underlying topics. These topics, in turn, are modeled as an infinite mixture based on a set of topic probabilities. In the realm of text modeling, the topic probabilities offer a transparent representation of a document's content. The descriptive analyze work on data collection from IEEE Xplore from 2011 to 2022 years.

Introduction

Artificial Intelligence (AI) in Education involves the integration of AI techniques into traditional learning methods, with the aim of automating or replicating existing educational practices. However, much of the focus has been on replacing or diminishing the role of teachers, rather than assisting them in improving their teaching effectiveness. While this approach may be beneficial in areas with limited access to teachers, it fails to recognize the unique skills and experiences that teachers bring, as well as the importance of social learning and guidance for learners.

Instead of simply automating computer-based instruction, AI has the potential to expand the possibilities of teaching and learning that are otherwise difficult to achieve. It can challenge existing pedagogical approaches or assist teachers in enhancing their effectiveness. AI can support collaborative learning by facilitating AI-driven monitoring of student forums, enable AI-powered continuous assessment, provide AI learning companions for students, and offer AI teaching assistants for teachers. These applications of AI have the potential to revolutionize the educational landscape [1].

Furthermore, AI in Education can serve as a valuable research tool in the field of learning sciences, advancing our understanding of the learning process. By exploring the possibilities and limitations of AIED, we can uncover new insights and contribute to the improvement of educational practices.

In conclusion, this paper examines the challenge of modeling text corpora and other collections of discrete data from IEEE Xplore dataset. The objective is to discover concise representations of the items in a collection that allow for efficient processing of large datasets, while retaining the crucial statistical relationships that are valuable for tasks such as classification, novelty detection, summarization, and assessing similarity and relevance [2].

Latent Dirichlet Allocation LDA

Latent Dirichlet Allocation (LDA) has gained significant recognition as a prominent method in the field of topic modeling. This approach is particularly effective in analyzing collections of discrete data, such as text corpora. LDA

operates as a generative probabilistic framework, employing a three-level hierarchical Bayesian model. Each item in the collection is represented as a mixture of predefined topics, while the topics themselves are modeled as an infinite mixture based on topic probabilities. When applied to text modeling, LDA provides a comprehensive representation of a document's content, allowing for insightful analysis of its underlying topics and themes. Below are three steps explaining LDA model [3].

Step-1

Latent Dirichlet Allocation (LDA) transforms a Document-Term Matrix into two matrices, M1 and M2, which are of lower dimensions. Matrix M1 represents the document-topics relationship, while matrix M2 represents the topic-terms relationship. Matrix M1 has dimensions (N, K), where N corresponds to the number of documents and K represents the number of topics. On the other hand, matrix M2 has dimensions (K, M), where K is the number of topics and M signifies the size of the vocabulary. We have to improve these distributions, which is the main goal of LDA [4].

	K1	K2	K3	K
D1	1	0	0	1
D2	1	1	0	0
D3	1	0	0	1
Dn	1	0	1	0

	W1	W2	W3	Wm
K1	0	1	1	1
K2	1	1	1	0
K3	1	0	0	1
K	1	1	0	0

Step-2

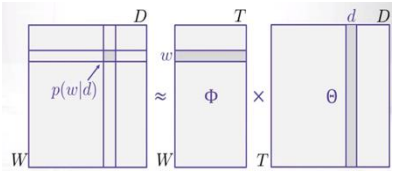
During this step, we go through each word "w" in every document "d" and aim to modify the current assignment of topics for the word. We assign a new topic "k" to the word "w" based on a probability P, which is determined by multiplying two probabilities, p1 and p2. To calculate these probabilities for each topic.

Step-3

During this step, the model operates under the assumption that all the word-topic assignments, except for the current word, are accurate. The model calculates the probability that a specific topic "t" generated the word "w". Based on this probability, it adjusts the assignment of the current word to a new topic. This adjustment is made iteratively, and over time, the model reaches a steady-state where the distributions of document topics and topic terms become reasonably accurate. This steady-state is considered the convergence point for Latent Dirichlet Allocation (LDA). We derived that P(w|d) is equal to: [2].

$$\sum_{t=1}^{T} p(w|t)\, p(t|d)$$

The above thing can be also represented in the form of a matrix (shown below):



By examining the provided diagram, we can draw a parallel between Latent Dirichlet Allocation (LDA) and matrix factorization or singular value decomposition (SVD). In both cases, we aim to decompose the probability distribution matrix of words in documents into two matrices: one representing the distribution of topics in a document and the other representing the distribution of words in a topic. This decomposition allows us to uncover the latent structure and relationships within the data.

Descriptive analyze

Based on the analysis of the IEEE Xplore dataset, the generated figure clearly illustrates a notable upward trend in the publication of papers focusing on the intersection of AI and Education from 2011 to 2022. Over the span of

ten years, there has been a significant increase, particularly in the recent years, with a substantial portion of these papers being presented at conferences.

In the second figure, it is observed that the proportion of papers containing the keyword "Education" within the subset of papers that also include the keyword "AI" remains relatively consistent from 2011 to 2022. This finding is unexpected since one would anticipate an increase in this percentage over time. However, the reason behind this observation can be attributed to the overall rise in the total number of papers published within the dataset.

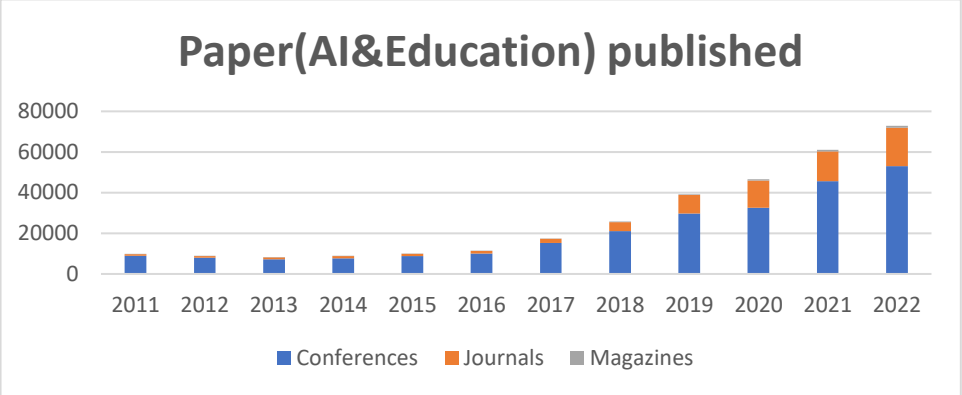


Figure 1. Papers in IEEE Xplore in the last years with key words “AI” and “Machine Learning” in Education [5]

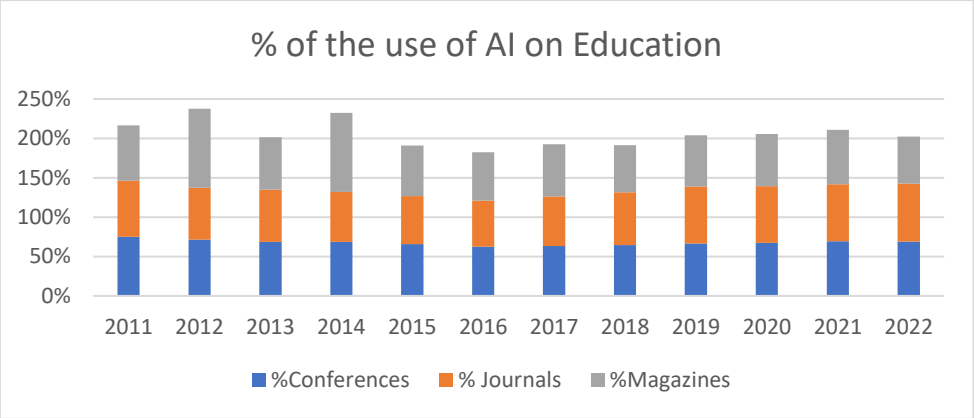


Figure 2. The percentage of Papers in IEEE Xplore in the last years with key words “Education” in papers with key words “AI” and “Machine Learning” [5]

Results and Conclusion

The application of AI algorithms and systems in education has garnered increasing interest over the years. Figure 1 illustrates the growing number of research papers published on the topics of "AI" and "Education" since 20101 based on data from IEEE Xplore. Throughout the period from 2011 to 2022, there is a notable consistency in the proportion of papers that incorporate the keyword "Education" within the subset of papers that also include the keyword "AI." As the field of education undergoes continuous development, scholars are actively investigating the application of cutting-edge AI techniques like deep learning and data mining. Their aim is to tackle intricate challenges and tailor teaching approaches to suit the unique needs of individual students.

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The stone bridges in Vjosa basin (Albania): Hidden values following roman tradition to the middle of 19th centuries

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Cite this study: Shumka, L., Papastefani, A., & Tataveshi, K. (2023). The stone bridges in Vjosa basin (Albania): Hidden values of cultural treasures. Advanced Engineering Days, 7, 148-150

Keywords
Bridges
Ottoman period
Cultural values
Heritage
Landscape

Abstract

The bridge is basically a utilitarian structure created to maintain communications in the face of difficulties in both an open natural environment and the man-made physical structure. The urge for people "to cross over to the other side" for existential concerns is related to the bridge's first appearance. As each time the conditional natural characteristics (geomorphology, river flows, water reservoirs, etc.) are presented, on the path of his physical barriers that frequently occur, they redirect travel routes and govern the lives of people and their communities, from the level of the individual man to the highest state level. Nowadays, bridges are present in entire Vjosa basin and its tributaries enabling communication along Vjosa itself, Shushica, Drino, Langarica, Zagoria etc.

Introduction

Rivers and river gods played an important role in Greek mythology [1]. Potamoi (Rivers) were thought to be offsprings of the Titan Okeanos (Ocean), son of Gaea (Earth) and Ouranos (Sky), and Tethys. On the long historical contexts, the mountain ranges on both flow sides of River Vjosa provide no barriers against human invasions from the north or east. Their presence shaped different aspects of hydrology, land use and resources utilization. Rivers of the Balkan area has been inhabited permanently since the Middle Palaeolithic [1-3]. It was the first area in Europe where farming cultures and livestock raising were established during the Neolithic era [4-8].

In most of instances within Vjosa, limestone was used for riverbank walls, as bridge cobble stone, and for the lower parts of the structure to the height that can be attained by water at higher water levels. Within regard the spectacular example is Brataj Brìdge of 18 centuries connecting Shushica with Vjosa basin.

A historical context enables us to get a precise understanding of the effects a communication route with regional character has. Within southeast Albania where landscape diversity and inhabited centers were scattered the communication needs were of primar importance. The Road of Aous (spread along Vjosa) was used in antiquity to connect fortified villages along the Valley of Vjosa with political and administrative hubs. Additionally, it acted as a transitional area between the era's political and economic entities. Cities like Apollonia, Bylis, Amantia, Antigonea, Adrianopoli, etc., which were not by mistake positioned on the banks of the Vjosa, and therefore had extensive economic, political, and cultural relationships. This route was especially notable for its numerous connection hubs, including Stefana, Nymfeu, Gurzeza Klosi, etc., through which products, armies, travelers, etc. were transported, elevating this region's prestige to that of the Balkans [9]. Historically, the markets created the communication arteries where bridges were the most significant components.

Material and Methods

Site visit along the Vjosa valley (covering main river and its tributariues Drini, Shushica, Benca, Langarica and Zagoria) has been conducted in the period of May 2022 until June 2023. Site documentation (measurement, photography) was combined with a systematic review of the literature. The work was focused on peer-reviewed

studies, and scientific reports regarding Vjosa basin that were written in English and published online. The data search was conducted in three comprehensive databases of scholarly publications- Web of Science, Google Scholar and Scopus between January 1995 and December 2022. All results were evaluated for relevancy and to avoid papers that were not related to our focus for each search-string. Examples of the search-strings include: ottoman period, architecture of bridges, Vjosa landscape, old bridges, medieval bridges, conservation, heritage profile, southeast Albania, etc.

Figure 1. Most notable bridges of Vjosa basin: (a) Brataj-Shushica; (b) Nivani-Zagoria; (c) Kadiu-Langarica and (d) Kordhoca-Drino

Results and Discussions

Following the analyses, the bridges along Vjosa valley falls into three construction types: (a) bridges with typical continuous of similar or almost similar shapes; (b) bridges with arches of odd number, in ascending and descending order, where the highest arch is located at the middle of the section and (c) with even number in ascending and descending order with a highest pie in the middle of the bridge [6, 10, 11].

Following [15] in similar period of time and style of construction, when processing stone for use in a masonry structure, the first working operation is usually the stone splitting so that a suitable form for grinding and further processing can be obtained. This has been observed in all bridges in our case, particularly in that of Nivani and Langarica. Further on according to [15], completely carved or semi-finished stone is processed in free form from natural banks or from already cut out regular pieces of stone. Pieces of stone and smaller monoliths can be carved as a fully-scaled stone (fully carved stone with a prominent middle part of the forehead) and as semi-finished stone with a flat front surface. The shape of the stone element that is being processed represents a carving characteristic as well. The form is usually parallelopipedic or prismatic, although the form can also be quite complex. This description was clearly evidenced in our visited locations along Vjosa valley.

Bridges construction is fitting with period of 16th – 19th century, once the territory of Albania was part of the Ottoman Empire, and in that part of the periphery of the empire where the appearance: large desire and enormous efforts for its expansion to the west of Europe. That has been confirmed by [6] for the Bosnia and Herzegovina. The practice of construction of persistent, demanding and expensive engineering stone bridges communications provided stability and intensity of life of the Empire, and enabling local communities to secure movement, trade, communication. For the case of large bridges as Vjosa and scattered communities this has been

of vital importance. Looking to the style in nowadays bridges were built experienced engineers enabling survival upon large period of time. Since an existence, the bridge should be reliable and stable construction, which summarizes its totality best and most sublime of human essence [6]. The aesthetic values and right integration into landscape is also a message that need to be translated within current construction activities that include roads, bridges, housing, etc.

Conclusion

The bridges are testimony of engineering capacities and visions, while the importance of communication, and thus the importance along the communication barriers reflect the society needs and concerns for integrating development into surrounding landscape. This article intends to confirm the values along Vjosa Bridges, needs for conservation measures. Further on it examine the effect of the bridge, explore the range of its complexity on regional contexts, in line with society needs and development.

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Modeling and simulation of robotic hand pressure sensor in Simscape

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Cite this study: Metalla, J., Dume, G., Basholli, F., & Ndokaj, E. (2023). Modeling and simulation of robotic hand pressure sensor in Simscape. Advanced Engineering Days, 7, 151-154

Keywords
Simulation
Modeling
Pressure sensor
Arduino

Abstract

The main advantage of humanoid robots over other devices is that they are more flexible and can be used for many purposes. In this project, a human-like robotic hand is designed and used for a task commonly performed by humans, namely grasping an object. During this study, the main focus will be the use of pressure sensors and the interaction between them to create an approach as close to reality as possible. For the various simulations and sensor testing, the Simscape and Solidworks applications were used, respectively, which enable the connection between the sensor and mechanical part of the robotic hand. An Arduino was used to build the algorithms, implement these instructions and control the sensors.

Introduction

Modern robotics is a widely studied field that has been around for many decades. Robots have been used in many fields and for many different applications, such as autonomous vehicles in the automobile industry, in the medical field in robot-assisted surgery, and in the industrial robot manufacturing industry. The list of robot applications comes and grows over time. One segment studied within this emerging community is humanoid robotics. The objective of humanoid robotics is to develop human-like machines that help and protect humans [1-3]. Different research groups, with different approaches, have been engaged in humanoid mechanics and control systems. In this study, the focus will be on the sensor approach to humanoid robotics, namely pressure sensors.

Material and Methods

The development in the field of electronics has reached a high level of integration, increasing the computational capabilities in ordinary objects. The possibilities of inclusion, offered by electronics, are many; digital circuits, actuators and embedded sensors. Industry and science are pushing the devices that are called "wearables".

"Wearable" devices are mainly used to collect information about the user and data related mainly to any physical activity or physiological parameters. Wearability is one of the important points in their design while the focus remains on the reliability of the measurement without hindering the user. Accuracy and reliability play an important role especially in health and sports applications. Force sensors are sensitive to deformations in all directions and are therefore used in conjunction with an electrical circuit, the Wheatstone bridge, which helps amplify a small change in resistance. The most used pressure sensors are FSR (force sensing resistor) often named as piezoelectric sensors or force sensors. They are resistive sensors that rely on different working principles. Force sensors rely on changes in the physical dimensions of the conductor such as; length and width, while resistive force sensors rely on changing the conductivity of the sensor itself. The resistive force sensor changes its resistance in relation to the change in its shape, traction or compression, as a result of the force applied to it. Equations for strain measurement in these types of sensors. $R = \rho \frac{L}{A}$ R (resistance), L (conductor length), A (conductor cross-sectional area)

$FS = \frac{\Delta R / R}{\Delta L / L}$, where FS (mechanical stress factor), ΔL/L = ε

Matlab is a programming and numerical computing platform used by a large number of engineers and scientists for data analysis, development and creation of models. Simscape allows you to create models of physical systems within the Simulink development environment. The models that are created rely on physical connections and can be combined to build schematics. The analysis is done by means of Simscape which defines and solves the system of equations that make up the constructed scheme. Arduino is a low-cost programmable platform, with which you can build "ready" circuits of all kinds for many applications, above all in the field of robotics and automation. It is based on the ATMEL microcontroller, ATMega168/328 [4-7].

Results and Discussions

Robotics enjoys a special interest and a growing demand in many directions; both for humans but also in the automation of industry. Tools like Matlab and Arduino development boards speed up and reduce the cost of building systems by leveraging the capabilities of computing machines. Matlab Simscape is a tool that can be used to solve a variety of problems while Arduino significantly reduces the costs of prototyping systems. The use of Simscape also reduced the calculation time during intermediate tests and since it is built taking into account the physical changes of the connected elements, it brings the simulation part closer to the real world [8-9].

Now we will illustrate the steps of the simulation through figures step by step:

1-The model of a permanent magnet dc electric motor is built by connecting different functional blocks of Simulink. (Figure 1) Demonstrates how signals (information) are converted into physical quantity value changes in Simscape and vice versa. Simscape and Simulink can be used in the realization of schemes, for this Simulink uses conversion blocks to migrate to Simscape.

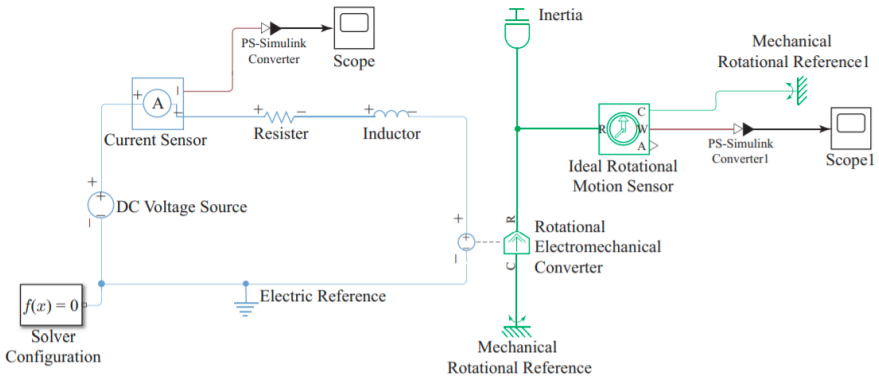

Figure 1. Modeling dc motor in Simscape

2-In Figure 2 (second image) Coupling circuits for the force sensor. Voltage divider circuit using Simscape and Simulink.

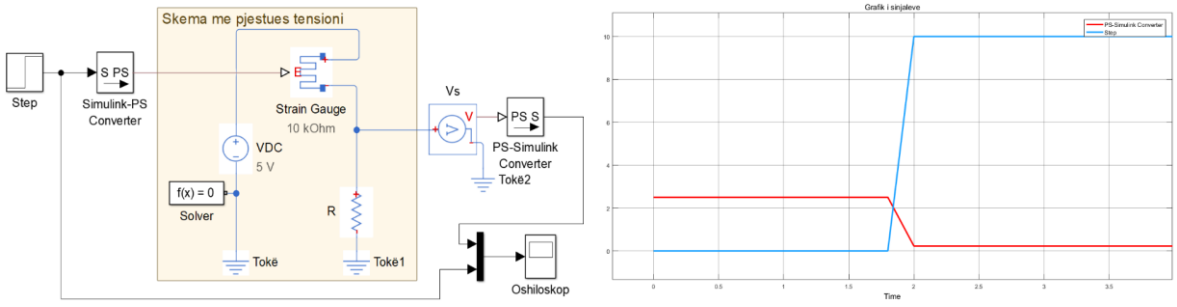

Figure 2. Modeling the force sensor circuit with voltage divider in Simscape.

3- This model shows how to model a pressure sensor together with the measurement made by the amplifier. (Figure 3) The sensor is located in one leg of the Wheatstone bridge, which is connected to a differential amplifier.

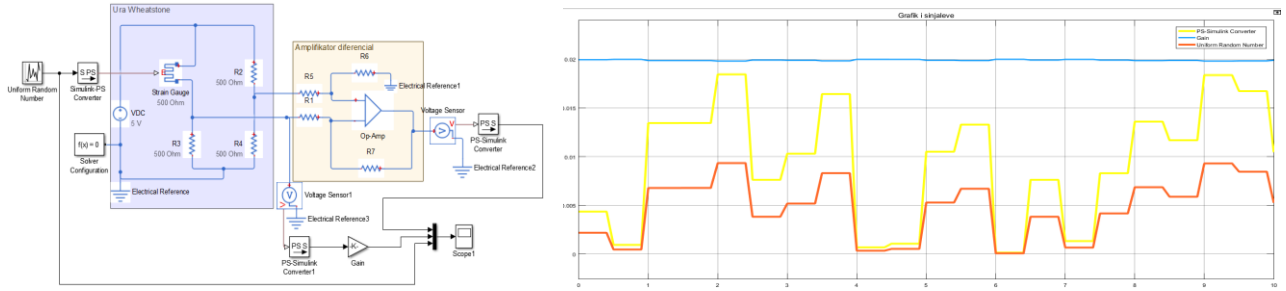

Figure 3. Graphs of simulated signals in Simscape of voltage divider with force sensor and Op. Amp

Results

The table shows (Table 1) the calculated values for the resistive values of the sensor and the resistance of the voltage divider, the voltage value at the output of the divider for the force range exerted on the pressure sensor in the range 0 N – 53.94 N. This force range belongs to the weight range 0 g – 5500g, the requirements are up to 5 kg weight per sensor. The calculations above are needed for circuit design as well as for comparison with real values [10-12].

Table 1. Calculated force sensor values

Force	Mass	R_{FSR}	$R+R_{FSR}$	I_{FSR+R}	V_{out}	V_R
0 N	0 g	Infinit	Infinit	0 mA	5 V	0 V
2.45 N	250 g	100 kΩ	110 kΩ	0.13 mA	2.14 V	1.3 V
4.9 N	500 g	30 kΩ	40 kΩ	0.13 mA	2.14 V	1.3 V
12.75 N	1300 g	15 kΩ	25 kΩ	0.2 mA	1.87 V	2 V
26.48 N	2700 g	10 kΩ	20 kΩ	0.25 mA	1.66 V	2.5 V
49.03 N	5000 g	7 kΩ	17 kΩ	0.29 mA	1.46 V	2.9 V
53.94 N	5500 g	6 kΩ	16 kΩ	0.31 mA	1.36 V	3.1 V

Conclusion

This work attempts to facilitate the classical mathematical modeling of the physical system with the help of Simscape, a tool which uses a physical modeling approach for developing system models.

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Hardware in the loop technique for real-time control of electrical machines using LabVIEW software for laboratory works in electrical engineering faculties

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Cite this study: Dume, G., & Metalla, J. (2023). Hardware in the loop technique for real-time control of electrical machines using LabVIEW software for laboratory works in electrical engineering faculties. Advanced Engineering Days, 7, 155-157

Keywords
Virtual Instrument
Hardware in the Loop
LabVIEW
Laboratory work

Abstract

The rapid developments of science and technology of the last decade have given a fundamental change to the way of conceiving and solving problems in every field of science and in particular in engineering disciplines. Nowadays, Virtual Instruments are becoming an important part of solving engineering problems in particular in the area of Automatic Control of Industrial Processes and Education. Due to the continuously increasing performance and flexibility of PC combined with their cost reduction, virtual instruments are successfully concurring the traditional instruments. In this work, we have created a closed-loop control system for testing the PID controller for a DC motor using the HIL technique and Ziegler-Nichols tuning rule for education purposes.

Introduction

The rapid developments of science and technology of the last decade have given a fundamental change to the way of conceiving and solving problems in every field of science and in particular in engineering disciplines.

The revolution of personal computers (PC) has placed them in the position of an indispensable tool in solving many problems encountered by engineers in practice.

Until the 1990s, the focus was on computer architecture, which would be used in industry for a specific task, but today attention is increasingly directed towards the so-called: software architecture [1].

From several years of work, with students during teaching practices in several industrial enterprises, we have established that the process of control and monitoring of production lines is carried out by special software of leading companies in the respective fields.

From the teaching point of view, to build the applications in the laboratory, all engineering problems deal with some physical quantities such as potential difference, electric current, temperature, pressure, speed, position, mechanical torque, moisture level, etc. We can see these quantities by using a computer coupled with conditioning circuits, data acquisition, transducers, and software. Moreover, these data can be processed, and stored, and even we can publish them on the Internet. Figure 1 illustrates an experimental test bed supported by the computer in real-time.

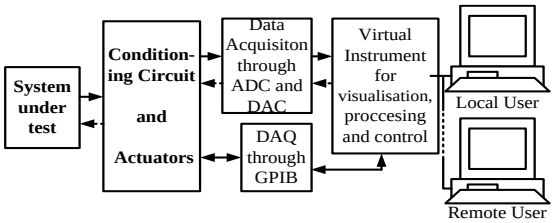

Figure 1. Block diagram of a laboratory test bench based on PC

At the Automation Department of the Electrical Engineering Faculty in Tirana, we are working on implementing LabVIEW software, a well-known software for measurement, data acquisition and visualization, in creating new

prototypes of controlling desired parameters of electrical machines, since it is also a programming language. Below is an illustration of the concept of this implementation.

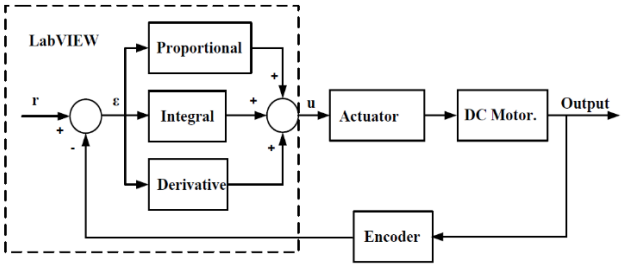

Figure 2. Block diagram of using LabVIEW as PID Controller for DC Motor Speed Control

In this work have built a virtual instrument for speed control of ***220V, 1500 rev/min Separately Excited DC Motor*** in our Electrical Measurement Laboratory "Fig. 3" and tested for finding the PID controller coefficients using the so-called Hardware in the Loop (HIL) technique and Ziegler-Nichols empiric tuning rule.

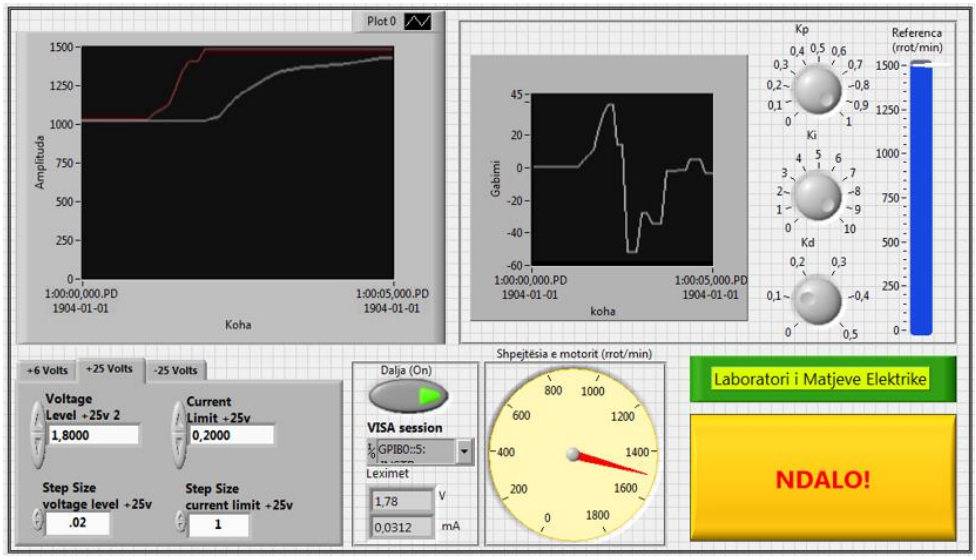

Figure 3. Virtual Instrument for DC Motor Speed Control and Monitoring

Material and Method

To build the DC Motor speed control Virtual Instrument we relied on [2-3] for instrument programming.

For the DC Motor formulas and theory, plenty of literature can be found on the internet. However, we are referring to literature in Albanian [4] for the equation of the DC Motor angular speed –ω, that is:

$$\omega = \frac{U_i}{k \cdot \varphi} - \frac{R_i}{(k \cdot \varphi)^2} \cdot M \tag{1}$$

Where U_i- is the armature voltage, R_i – armature resistance, M- motor torque, k- a coefficient and φ-field flux.

To measure the motor angular speed we have used an incremental encoder from Baumer model ITD 40A with 1024 pulse/rev, NI 6008 USB DAQ and LabVIEW to build a virtual instrument used as a subVI in the top application (Main VI).

The control of the motor speed is done by changing the armature voltage under the rated value by using a custom-built AC-DC converter [3]. The set point of the driver is set programmatically by the programmable power supply Agilent E3631A through the GPIB interface.

The Separately Excited DC motor coil is fed by a constant 220V DC voltage obtained by the LabVolt power supply used in the laboratory.

We built in LabVIEW also a soft starter to start the DC motor from the standstill to its rated value of 1500 rev/min by generating a ramp signal from the programmable power supply. The Overall system for DC Motor speed control is shown in "Fig. 4".

The Virtual Instrument graphical code is shown below. It consists of 2 frames. The first frame (left) picture in "Fig. 5" soft start the DC motor and the second frame (right picture) is used to monitor the motor angular speed and to find the desired PID controller coefficient by interacting with the DC motor using the HIL technique and Ziegler-Nichols empiric tuning rule.

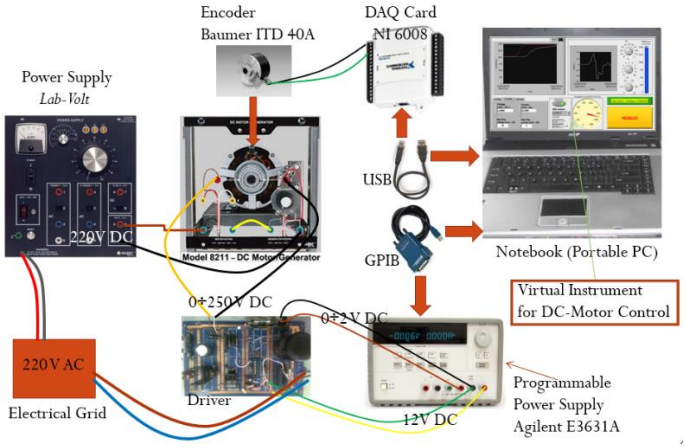

Figure 4. Overall system for DC Motor speed control

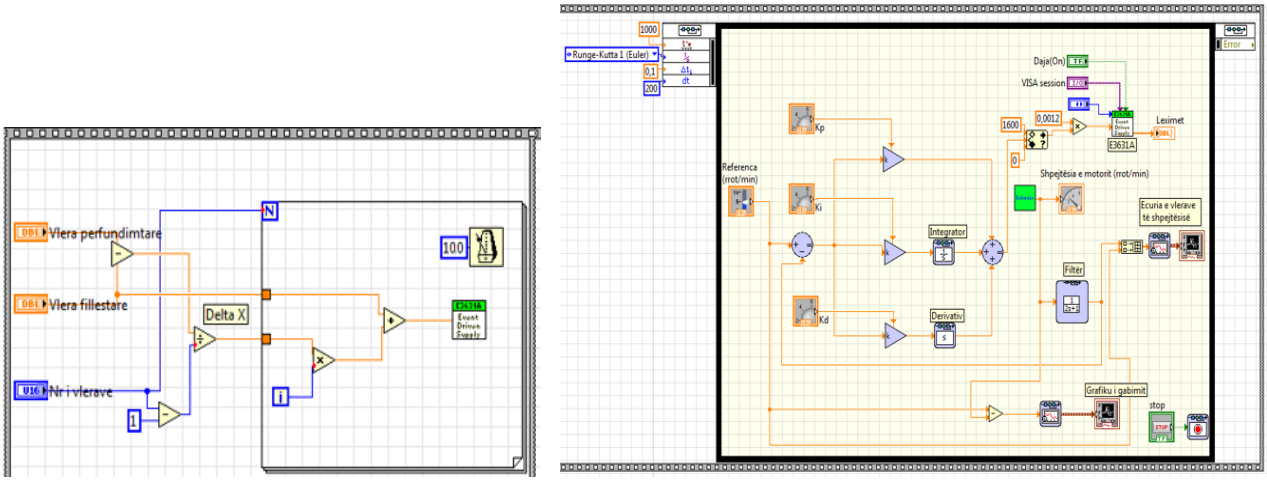

Figure 5. Virtual Instrument block diagram

Results

From a teaching point of view, the speed control of a DC Motor with the LabVIEW software can be used to carry out laboratory work on the subject of Electric Drives, allowing the students to become familiar with computer-based control systems, despite the limitation in infrastructure, which our laboratories have in our faculty.

Discussion

This approach lacks the problem that there must be always qualified personnel in the laboratory during tests to survey for any problem students may face during experimentation because the controller coefficient can be changed in real-time and can lead to unexpected behavior of the machine if not found correctly.

Conclusion

From an educational point of view, using this approach it is possible to help some of the laboratories in the Electrical Engineering Faculties which lack the infrastructure to perform specific laboratory work so the students narrow the gap between theory and practice.

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Methods and software for calculating total electronic content based on GNSS data

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Cite this study: Naumov, A. O., Khmarskiy, P. A., Byshnev, N. I., & Piatrouski, N. I. (2023). Methods and software for calculating total electronic content based on GNSS data. Advanced Engineering Days, 7, 158-160

Keywords
Ionosphere
Radio tomography
Total electronic content
Global navigation system

Abstract

Methods for determining the total electron content in the ionosphere by global navigation system signals are investigated. Methods for correction phase ambiguity due to «cycle slip» and determining differential code delays are proposed and implemented. Software for finding the full electronic content and constructing maps of vertical full electronic content over the territory of the Republic of Belarus was developed.

Introduction

Relevance of the study of processes occurring in the ionosphere is due to the fact that the spatial and temporal inhomogeneities of the electromagnetic field in the upper atmosphere of the Earth play an important role in the functioning of modern technological systems [1-3]. For example, maintenance of serviceability of equipment installed onboard satellites, accuracy of objects location with global navigation satellite systems, characteristics of radio-wave propagation, ground-based electrical generating, electrical and pipe-line systems operation depend on knowledge of upper atmosphere state at ionospheric heights.

One of the most effective ways to study ionosphere is radio sounding using high orbital navigation satellites [1-3]. Currently, there is a network of 96 continuously operating points of the precise positioning satellite system on the territory of the Republic of Belarus, which can be used for measurements. Data from these stations allow us to calculate the total electron content (TEC), which describes the number of electrons on the line connecting the satellite with the ground receiving station. Based on the TEC, the vertical total electron content (VTEC), which characterizes the integral concentration of electrons in a vertical column above a given point on the Earth's surface, is found.

Material and Method

The passage of electromagnetic signals through the ionosphere depends on the concentration of free electrons in it. In addition, the effect of the ionosphere on radio signals depends on the frequency of the signal, i.e. ionosphere is a dispersing medium. This effect changes the speed of propagation of signals with respect to the speed of light due to the presence of a refractive index other than 1. Depending on whether the group or phase of the signal is considered, these refractive indices will be different. They are related by the following expression [4]:

$$n_{gr} = n_{ph} + f\frac{dn_{ph}}{df}$$

where n_{gr} and n_{ph} are refractive indices for group and phase signals, f - signal frequency.

The total electron content is defined as the integral of the electron density along the path between the satellite and the receiving station: $TEC = \int_S n_e(s)ds$. It is expressed in TEC Units (TECU), where 1TECU is defined as 10^{16} electrons contained in a cylinder with a cross section of 1 m^2, aligned with the beam path. TECU can be calculated both by the difference between pseudoranges P_1 and P_2, and by the difference between phases L_1 and L_2 by the following formulas [4]:

$$TEC_{gr} = \frac{1}{40,28}\left(\frac{f_1^2 f_2^2}{f_1^2 - f_2^2}\right)\left[P_2 - P_1 + c\left(D_r + D_s\right)\right],\ TEC_{ph} = \frac{1}{40,28}\left(\frac{f_1^2 f_2^2}{f_1^2 - f_2^2}\right)\left[\lambda_1 L_1 - \lambda_2 L_2 - N + c\left(D_r + D_s\right)\right],$$

where λ_1 and λ_2 are wavelengths corresponding to frequencies f_1 and f_2, c is the velocity of light in the vacuum, N is phase ambiguity due to the integer number of wavelengths at the measurement distance, D_s и D_r are the differential code delays in the satellite and receiver apertures.

TEC calculations were performed with the so-called non-geometric linear combination of two frequencies L_1 and L_2, which contains only ionospheric information. The TEC obtained from phase measurements is smoother than that obtained from code measurements for phase measurements, it is additionally necessary to correct the initial phase ambiguity associated with cycle slip. For this purpose, the method described in [5] was used.

For a number of problems, the TEC value is not very convenient, because, firstly, it strongly depends on the angle of elevation of the satellite, and, secondly, it cannot be referred to any specific point of space. More convenient is a quantity called the vertical total electron content, which is defined as the integral concentration of electrons in a vertical column above the Earth's surface. For this purpose, some height h is chosen, at which the center of gravity of the electron concentration is located. The point at this chosen height is called the Ionospheric Pierce Point (IPP) and is defined as a point on the beam connecting the satellite to the receiver at the chosen height above the Earth's surface. In the following calculations, this altitude was set to h = 504 km. The WTPP is calculated from the IPP values using the formula: $VTEC = TEC \cdot \cos\chi$, where χ is the elevation angle of the satellite.

In this work, we used a method based on [6] to estimate the differential code delays D_s and D_r. The satellite and receiver delays D_s and D_r are considered unknown parameters, which are calculated using the method of least squares using the values of the vertical total electron content.

Results and discussion

Software for processing radio-tomographic data of high-orbit ionosphere control provide implementation of methods and algorithms for obtaining, processing and storing data on ionosphere conditions over the territory of the Republic of Belarus and neighboring countries, received on the basis of radio signals from high-orbit navigation satellite systems, fixed by the satellite system of precise positioning of the Republic of Belarus (SSTP RB). The software will be a part of space system of radiometric control of near-Earth space based on ICA and specialized ground facilities, which will make it possible to increase the safety level of operation of complex infrastructure objects on the territory of the Republic of Belarus.

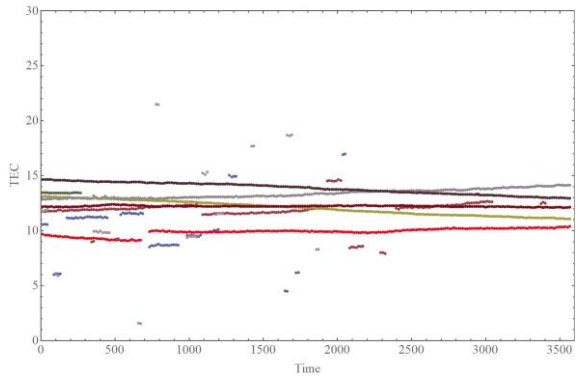

Figure 1. Values of electronic contents before cycle slip correction

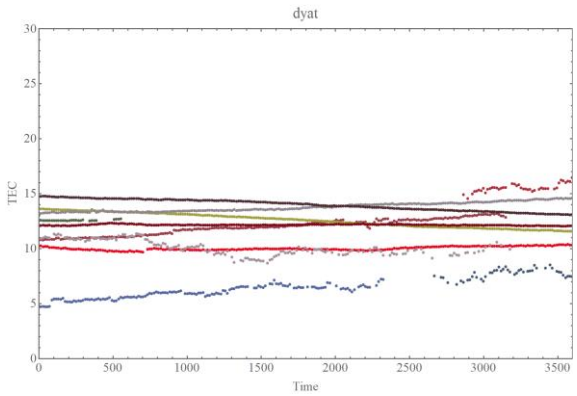

Figure 2. Values of electronic contents after cycle slip correction

The software is written in the Python programming language version 3.10, using third-party cross-platform free libraries Matplotlib, NumPy, Plotly, SciPy, georinex, Pandas, pymap3d, Xarray, PyKrige, GeoPandas.

Figure 1 shows the values of total electron content before the cycle slip correction, obtained from the phase pseudorange of GPS satellite signals for May 5, 2022, between 00:00:00 and 01:00:00 UTC. Figure 2 shows the

same values after the cycle slip correction. It can be seen that the outliers associated with slippage are effectively corrected by the used algorithm.

As an example of the operation of the algorithm for determining the differential code delays, we present the results of calculation of the total electronic content using data from May 5, 2022 from the observation station "Borisov", located in the city of Borisov. Figure 3 shows the values of total electron content before the correction of differential code delays for all 32 GPS satellites. Figure 4 shows the same values after the differential code delay correction.

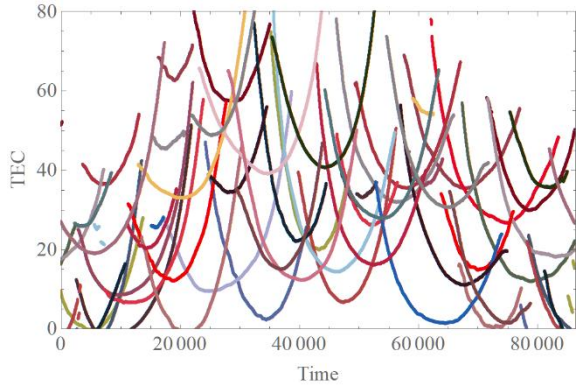

Figure 3. TEC values before differential code delay correction

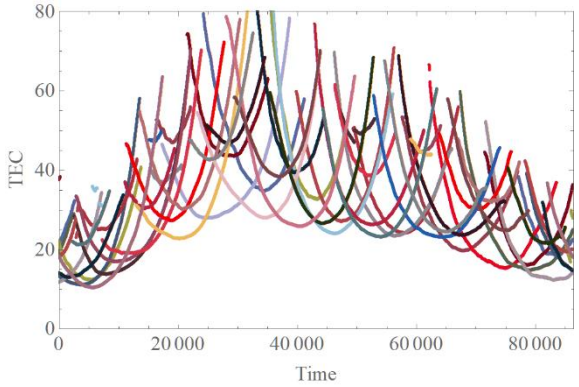

Figure 4. TEC values after correction of differential code delays

An example of calculation of the vertical total electron content at different points in time on May 05, 2022 according to data from 15 observation stations and GPS satellites is shown in Figure 5.

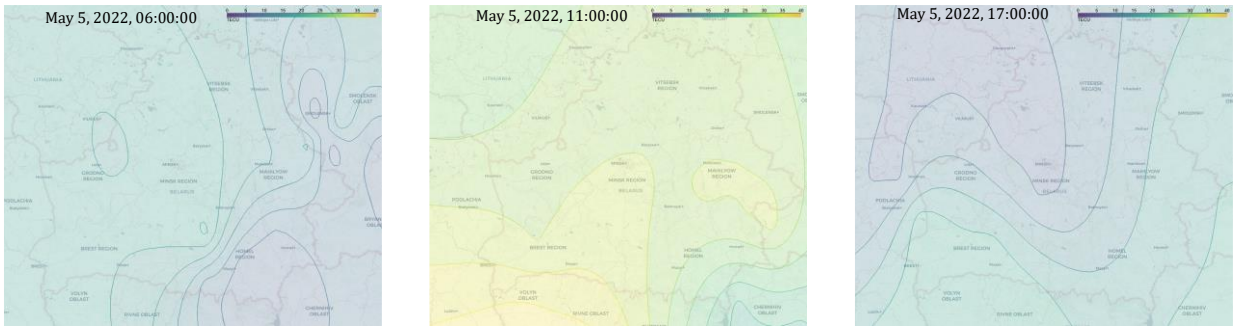

Figure 5. Example of Calculation of Vertical Total Electronic Content over the Territory of the Republic of Belarus

Conclusion

Methods and software tools for calculating total electronic content from data of global navigation satellite systems are presented. Further direction of work - three-dimensional reconstruction of the electron content in the ionosphere on the basis of the obtained data.

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Vjosa Basin-the first free flow river protected area in the Balkans (Albania) from fish diversity richness prospective

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Cite this study: Mucollari, N. (2023). Vjosa Basin-the first free flow river protected area in the Balkans (Albania) from fish diversity richness prospective. Advanced Engineering Days, 7, 161-163

Keywords
Fish species
Diversity
Abundance
Vjosa river
Threaten

Abstract

Vjosa River, an ecologically important area and the last Europe free-flowing river, is an essential aquatic ecosystem for the Albanian ecological, social, and cultural aspects. The Vjosa river is home of at least 34 species of fishes inhabiting the river and delta system, of which 29 are native, including eight species endemic to the Balkans. With 12 species, Cyprinidae are by far the most specious family, followed by Mugilidae (five). Salmonidae and Acipenseridae are represented by 2 species each. The remaining ten families are represented by a single species. At least four species (Pseudorasbora parva, Oncorhynchus mykiss, Carassius sp., Gambusia holbrooki) were introduced into the Vjosa basin. The lower river reach is populated by other species as: European eel (Anguilla anguilla), species of Family Mugilidae (Mugil cephalus, Liza ramada, Liza salienes and Chelon labrosus), Seabream (Sparus aurata), Seabass (Dincentrarchus labrax), Flatfish (*Platichthys flesus,* Common sole (Solea spp.) etc*, while* the resident species associated with saline water incluce, are numerically prevalent with the two species *Atherina boyeri* and *Aphanius fasciatus* showing presence and significance.

Introduction

Albanian watersheds are defined as distinct river basins or isolated sub-basins, usually defined naturally by watershed boundaries. In Albania, there are several large, temporally independent river and lake systems. From north to south, they are arranged as follows: Drini (Ohrid-Drin-Skadar system including the Buna River), Mat, Ishëm, Erzen, Shkumbin, Seman (consisting of two major tributaries - Devoll and Osum), Vjosë (Aoos in Greece) river systems, several short rivers flowing from the Cika Mountains to the southernmost part of the Adriatic Sea and to the northernmost part of the Ionian Sea, the area around the Butrint lagoon (rivers Bistrica and Pavllo) and Lake Prespa (Figure 1). Most of the above lakes and rivers belong to the catchment area of the Adriatic Sea and the southernmost areas to the slope of the Ionian Sea. Only a very small area in the northernmost part of Albania, in the Albanian Alps, is part of the Danube River basin. The area covered by this study corresponds to Vjosa basin and as stated above it lies at the Adriatic Basin.

The differences in geological settings and structures, physico-chemical characters of water in the different drainage basins enables different conditions for the development of fish communities, within Adriatic watercourses. That has also enabled speciation processes. It is worth to mention fact that the waters belonging to different basins have been under the influence of different conditions and events.

With a catchment of 6700 km^2 the Vjosa has a mean annual discharge of 204 m^3/s. While the discharge during dry periods (Summer) drops down to levels of 40-50 m^3/s, annual flood events show a magnitude of >1000 m^3/s. This river shows a very active sediment regime with an estimated transport at the Pocem bridge of 5 million tons per year. The sediments mainly consisted of the substrate classes psammal, akal and mikrolithal [1, 2]. The native ichthyofauna of the River Vjosa reflects the rich geological past and geographic position of the basin, given the large number of *Near Endemic* species (Species almost entirely found within Vjosa territory and most of them are found in two lake systems shared with neighboring countries i.e., Albania and Greece) and *Endemics Balkans* (Species restricted to the southern Balkans, specifically, to the Southeast Adriatic). There are species in the genera *Oxynoemacheilus*, *Cobitis and Pelasgus*.

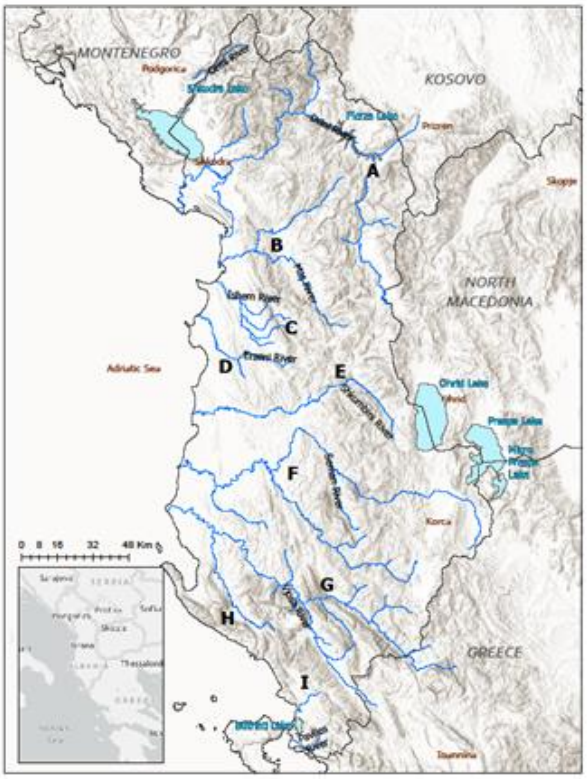

Figure 1. Albanian River basins

Material and Methods

A systematic review of the literature has been conducted following the guidelines of [3]. The work was focused on peer-reviewed studies, PhD and Master's theses, and scientific reports regarding Vjosa basin that were written in English and published online. The data search was conducted in three comprehensive databases of scholarly publications- Web of Science, Google Scholar and Scopus between January 2000 and December 2022. The preliminary assessment has been conducted of a subset of articles prior to the main search to determine the search-string combination to utilize. All results were evaluated for relevancy and to avoid papers that were not related to our focus for each search-string. Examples of the search-strings include: water quality parameters, fish diversity, decline factors, management, conservation, livelihood profile, etc. Then, I found 59, 11, 8 peer reviewed papers from Google scholar, web of science and Scopus, respectively. Finally, I was reviewed 33 papers.

Results and Discussions

The very recent research and literature data focused to the freshwater of Albania and River Vjosa have confirmed that the current fish fauna consists of 34 species from 10 orders and 14 families [4-12]. Among them 29 species are native to the River Vjosa basin: with 12 species, *Cyprinidae* are by far the most specious family, followed by *Mugilidae* (five). *Salmonidae* and *Acipenseridae* are represented by 2 species each. The remaining ten families are represented by a single species. At least five species (*Pseudorasbora parva*, *Oncorhynchus mykiss*, *Carassius gibelio, Chtenopharyngodon idella* and *Gambusia holbrooki)* were introduced into the Vjosa basin. The lower river reach is populated by other species as: European eel (*Anguilla anguilla*), species of Family*Mugilidae* (*Mugil cephalus, Chelon ramada, Chelon salienes* and *Chelon labrosus*), Seabream (*Sparus aurata),* Seabass *(Dincentrarchus labrax)*, Flatfish (*Platichthys flesus,* Common sole (*Solea* spp.) etc, while the resident species associated with saline water incluce, are numerically prevalent with the two species *Atherina boyeri* and *Aphanius fasciatus* showing presence and significance. The remaining four alien species, all introduced over the past 100 years as a consequence of human activity or unintentional one. According to the Albanian red list (MoE, 2013), three species are endangered (*Acipenser naccarii, Acipenser sturio,* and *Asphanius fasciatus)* and two vulnerable *(Petromyzon marinus* and *Platychthis flesus).* IUCN considers three species to be critically endangered *(Acipenser naccarii, Acipenser sturio* and *Anguilla Anguilla)* and additionally *Gobio skadarensis* is categorized as endangered. The Bern convention lists three species in Annex II (strictly protected fauna species) (*Acipenser naccarii, Acipenser sturio* and *Asphanius fasciatus*) and two as in Annex III (*Alburnoides aff. Prespensis, Chondrostoma vardarense, Pachychlion pictum* and *Petromyzon marinus*) [13-16]. There is a severe lack of knowledge concerning these systems compared to other systems in Europe, resulting in limited available data information about these species and their population status. This means that more species than previously thought could be severely threatened.

Conclusion

Given to the fact that nowadays, the aquatic and riparian fauna and particularly fish species in many river basins in Albania are at risk, the conservation approaches are of vital importance. Lowland section and deltaic system of Vjosa is at greatest risk due to changes in agricultural practices, current development large sale of infrastructure, tourism and large-scale modifications in headwaters. Following this, the WFD demands a reduction of human impacts to establish a 'good' water status, however, at present the Directive is only being implemented in EU country, but Albania as a candidate one has to consider the conservation and monitoring aspects.

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Research on the process of obtaining pure sesame oil using microwave processing

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Cite this study: Boykharayevich, F. J. (2023). Research on the process of obtaining pure sesame oil using microwave processing. Advanced Engineering Days, 7, 164-165

Keywords
Sesame seeds
Sesame oil
Microwave processing
Drying
Oil content
Degree of extraction

Abstract

The article provides information about the countries where grape seeds are most grown, about the healing substances contained in the seed oil kislots, vitamins, macro and microelements, as well as about their healing for various diseases. In addition, the article presents the results of research on the division of khoraki grapes into parts. Also listed are methods for producing oil from grape seeds. The results of studies of the effect of microwave treatment of sesame seeds on the yield of oil, cake is presented. The significant influence of the power and duration of the radiation process on the oil production indicators is shown. Optimal technological parameters have been established, at which the degree of oil extraction is 32.79%, cake 66.71%. The main parameters affecting the degree of oil release are the oil content of seeds, the power of microwave radiation and the duration of the process.

Introduction

Today, due to the lack of fresh water and the reduction in sown areas, the problem of providing the population with food is sharply exacerbated. In this regard, the intensification of technological processes, an increase in the yield of products obtained and an improvement in quality, including the processing of raw materials for medical purposes and healthy nutrition, the production of oils rich in polyunsaturated fatty acids, will become relevant.

In the world, with population growth, reduction of acreage and lack of fresh water, the problem of providing the population with food is sharply aggravated. In this regard, the intensification of technological processes, increasing the yield of products and improving quality are an urgent task of food production. In this aspect, the development of new, improvement of existing processing technologies, especially various non-traditional oil-containing seeds, is no less relevant. In the world, special attention is paid to obtaining oil from the seeds of stone fruits, crushed melon seeds, wheat germ, and pine nuts. At the same time, research work to determine the impact of the use of microelements and vitamins, the production of essential polyunsaturated fatty acids, increasing thermal stability using ultra-high frequencies and electromagnetic fields on human health are important [1-4].

Methods

Studies were carried out using Central Asian sesame with an oil content of 38.10%. Chemical analysis of the initial, intermediate and final products was carried out by known methods [5-8].

The acid number of oils was determined by O'zDSt 1203, and a 1% alcohol solution of phenolphthalein was used as an indicator [9-13]. The method is based on the titration of an oil sample with an alkali solution in the presence of the phenolphthalein indicator.

A neutralized mixture of alcohol and diethyl ether was used as a solvent for the oil.

Results and Discussion

Studies of the effect of microwave radiation on weight loss, the yield of oil and cake from sesame seeds were studied on an installation, the main node of which is a microwave oven. The radiation power varied from 100 to 300 watts at a frequency of 2450 MHz and the duration of the treatment process was 15 minutes. Studies have shown that at a radiation power of 120 W and above, the seeds are roasted.

To establish the effect of the duration of the microwave radiation process on the sesame oil yield, the seeds were kept in a microwave oven at a study power of 105 watts, a frequency of 2450 MHz and a study duration of 1 to 20 minutes. The results obtained are shown in Table 1.

Preliminary grinding of sesame seeds did not give a positive result. Therefore, further studies were carried out without grinding, by pretreating the seeds with steam at 250 ° C, for 30 minutes.

It can be seen from the table that with an increase in the duration of the sesame seed treatment process for 1-5 minutes, weight loss is not observed. With an increase in the duration of the microwave radiation treatment process from 10 minutes to 20 minutes, the mass loss increases from 0.25% to 1.00%.

Table 1. The effect of microwave radiation on oil extraction and cake yield

№	Time (Min)	Mass Loss (%)	Cake output (%)	Oil output (%)
1	-	-	81,39	18,61
2	1	-	77,84	22,16
3	3	-	72,90	27,10
4	5	-	68,86	31,14
5	10	0,25	68,20	31,55
6	15	0,50	66,71	32,79
7	20	1,00	74,92	24,08

Increasing the duration of the sesame seed treatment process increases the oil yield from the first minutes. So, when processed for 3 minutes, the oil yield increases by 8.49% and increases from 18.61% to 27.10%. The maximum degree of oil extraction is observed during processing for 10-15 minutes and is 31.55-32.79%. A further increase in the processing time to 20 minutes leads to a decrease in oil yield up to 24.08%.

Under optimal conditions of processing duration of 10-15 minutes, the yield of cake is the smallest and amounts to 68.20-66.71%.

Conclusion

Thus, the maximum degree of oil extraction is observed during processing for 10-15 minutes and is 31.55-32.79%. A further increase in the processing time to 20 minutes leads to a decrease in oil yield up to 24.08%.

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Research of the physical and mechanical properties of high temperature resistant copolymer coating

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Cite this study: Ruziev, R., Nurkulov, F., Rakhmankulov, A., & Djalilov, A. (2023). Research of the physical and mechanical properties of high temperature resistant copolymer coating. Advanced Engineering Days, 7, 166-168

Keywords
Derivatographic indicators
Acrylic emulsion
Heat-resistant coating
Thermomechanical analysis

Abstract

In the practical experiments of this research work, various additives and fillers added to increase the heat resistance of the acrylic-styrene composition coating. In order to study the thermal stability of the obtained sample, as well as to draw the appropriate conclusion, the derivatographic and thermomechanical parameters of the coating sample were obtained and analyzed in special measuring instruments. According to the results of the analysis, it found that the resistance indicators of the acrylic - styrene coating sample obtained in practical experiments are positive.

Introduction

In recent years, there has been a tendency to increase the production of products based on acrylic monomers and the volume of their consumption by 5-10 % per year. In particular, the volume of production of products containing acrylic in 2015 amounted to 6 million tons, while by 2021 it will amount to 7.65 million tons. According to industry experts, by 2026 this figure will reach 10 million tons, 16 % of the acrylic-based products currently produced correspond to the contribution of coatings obtained in the presence of monomers such as styrene, urethane, and vinyl.

Increasing the heat resistance of such products due to a removable acrylic-based coating was consider one of the urgent tasks, and important research is currently being conduct in this area. In this research work, the appropriate additives and fillers were included in the composition of the acrylic styrene coating, the heat resistance of which studied in practical experiments.

Material and Method

To obtain an acrylic-styrene paint composition with heat-resistant, coating properties, a 250 ml three-neck flask equipped with a mechanical mixer, a reverse cooler and a thermometer obtained in laboratory conditions. The flask heated to a temperature of 70-80 ° C in the state of acrylic emulsion, adding the appropriate amount of additives and fillers. The mixing speed is 3500 rpm for an hour until a dark-looking coating is form mixed at high speed.

In order to study the thermal properties of the resulting acrylic-styrene coating, derivatives and thermomechanical parameters analyzed [1-2].

Results and discussion

In the course of the study, the derivographic indicators analyzed in order to study the thermal nature of the acrylic-styrene coating formed in the presence of appropriate additives and fillers. According to the results, the DTA curve of the exothermic effect of this acrylic-styrene coating detected at temperatures of 240 and 357 °C, as well as the endothermic effect at temperatures of 30, 206 and 557 °C (Figure 1).

It found that the sample of acrylic-styrene coating, presented in accordance with the above drawing, is in the temperature range of 30-801 °C when studying the viscosity of mass loss under temperature exposure. At the same time, in the temperature range 206-557 °C, the maximum mass loss of the sample is 31%, and the minimum mass loss is 4.7%, manifested in the temperature range 557-801 °C. In turn, when the temperature exceeds 801°C, 59% of the sample remains intact. These stages of the process accompanied by an exothermic effect [3].

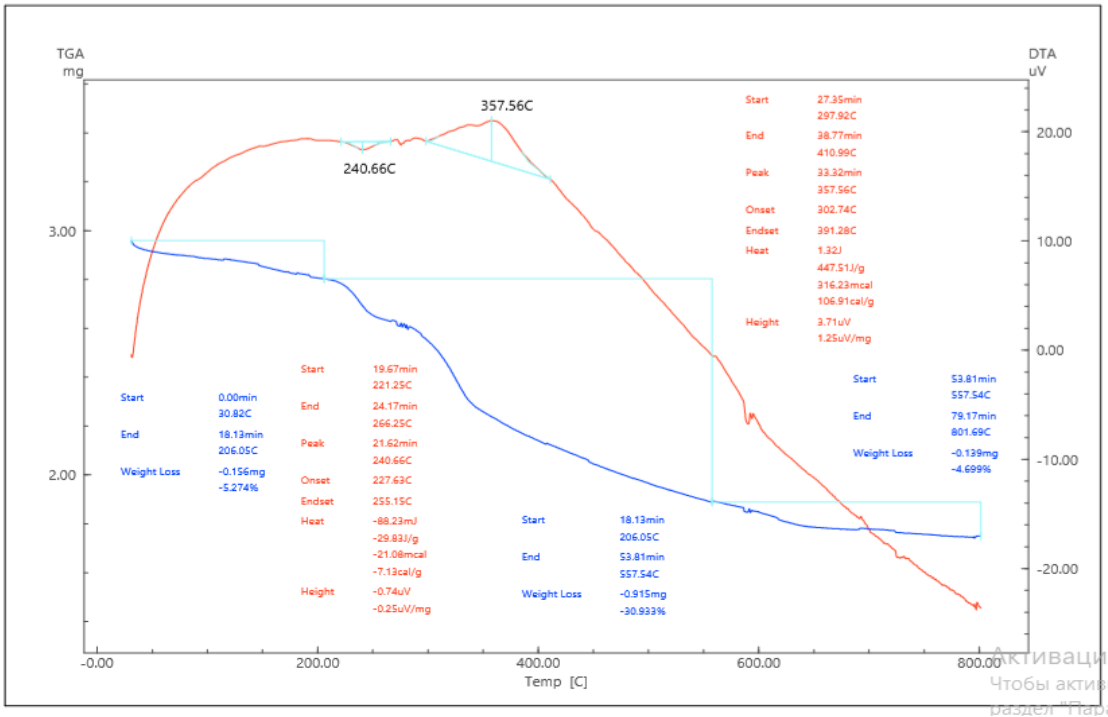

Figure 1. Derivatographic indicators of acrylic-styrene coating

Based on the results obtained by the methods of analysis of DTA and TGA derivatives of the sample, kinetic parameters for various temperature intervals of the process were determined. Its advantage determined by a number of measurements and calculation of kinetic properties over the entire temperature range of reactions from a single sample. In particular, it found that 41% of the total mass up to a temperature of 801°C of the sample from the acrylic-styrene coating composition subjected to thermal decomposition, and the analysis of the thermal decomposition of the acrylic-styrene coating composition obtained during the study was found positive.

In addition, the thermomechanical method used in the study of the thermal properties of the acrylic-styrene coating composition obtained during practical experiments. In accordance with this method, a certain unchanged bulk mass was applied to the surface of the sample. Based on the norms established in this case (ISO 11359), the temperature was increased in parallel with the constant force exerted on the surface [4-5].

The surface of the sample taken for this experiment and the strength calculation given to the sample were determined using the appropriate formulas. To study the thermomechanical nature of the sample obtained for the experiment, a control experimental work was carried out on the fact that its surface is 132 mk*m^2, the sample is under a constant force of 25 N, and in the range from 1°C to 460°C temperature using a special device.

According to the results of the experiment, it observed that the thermomechanical curve of the sample deformed without permanent changes up to 20°C of damage. Softening inversion of the sample deformation observed in the temperature range from 20 to 400°C. When the temperature increase continued, the transition of the sample to a highly elastic state at a temperature of 400°C observed.

During the procedure, when the temperature increased from 401 to 460°C, a constant deformation of the sample observed. The intervals of temperature change and deformation during the experiments shown in the Figure 2.

At the same time, during the experiment, when exposed to a sample with a force of 25 N, in accordance with the above calculations according to the formula, a constant pressure of 0.188 m n / m^2 arises with an increase in temperature [6].

In this process, the deformation of the sample in the temperature ranges from 1°C to 50°C in the case when the pressure and force remain unchanged is from 0 mm to 18 mm as long as no change has been observed. In addition, deformation at temperatures up to 50-100°C was 18 mm – 53 mm, in the range from 100-150°C to 53-60 mm, the deformation of the sample at 400-460°C was 451-510 mm. When the temperature given to the obtained samples reached 460°C, the highest state of deformation of 510 mm observed without changing the inversion index.

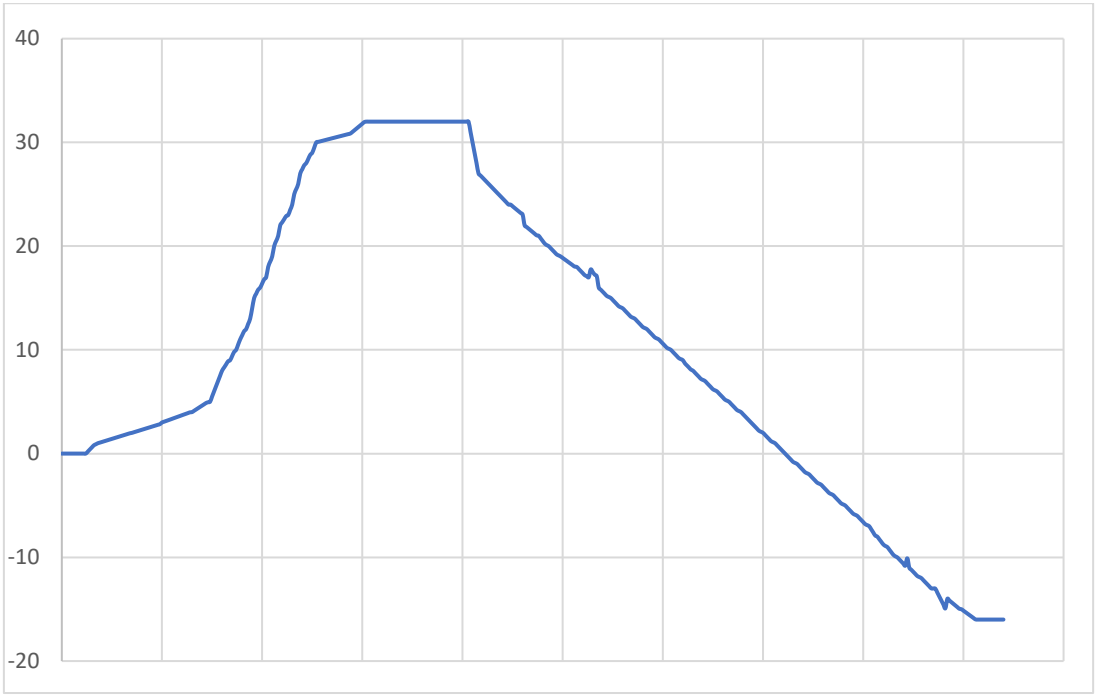

Figure 2. Thermomechanical curve of acrylic-styrene coating

Conclusion

Thus, appropriate additives and amulets were added to further increase the heat resistance of the acrylic-styrene coating obtained during practical experiments. The results of the thermostable and thermomechanical plasticity of the obtained coating sample found to be positive in comparison with their analogues in the analysis.

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General and comperative data on water ecology in Shkumbin River, Elbasan

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Cite this study: Myslihaka, S. (2023). General and comperative data on water ecology in Shkumbin River, Elbasan. Advanced Engineering Days, 7, 169-171

Keywords
Oxygen
Ecology
Bacteria
Water
E. coli

Abstract

It is essential importance the assessment and maintenance of the aquatic ecosystems for the well-being of the society since they are closely related to the human and environmental systems. In this study we have taken a part of Vidhas- Shkumbin river, Elbasan region in Albania, as a case study because it is an area massively affected by industrial pollution. From the general hydrobiological data, in this paper we give a full study on the comparative features of water ecology from physical-chemical, bacteriological data. Various analyzes have been performed based on some standard methodologies for the examination of water performed in the laboratory in terms of water quality determination of the chemical need for oxygen, dissolved oxygen, determination of nitrates, phosphates, ph, hardness and bacteriology. From the study of water in Vidhas-Shkumbin river, we came to the following conclusions: Water resources are of the phreatic type, the level of phreatic water varies depending on atmospheric precipitation, with general temperatures of 16 degrees Celsius, with a strength of 28 degrees German, mineralization occurs too high 160mg / l and from the bacteriological content the water appears mostly high because of presence of bacteria E.coli, Pseudomonas aeruginosa, Enterococci intestinal.

Introduction

In this study we have taken as a case of study Vidhas-Shkumbin river in Elbasan region in Albania. From the general hydrobiological data, the region consists on quaternary water-bearing complexes which mainly form the water-bearing basin of the middle part of Shkumbini Valley. The main importance of this study consists in the identification of ecological thresholds, how a pollutant input or the maintenance of a certain species can have a drastic reaction in the ecosystem. The transition from a clean aquatic ecosystem to a turbid aquatic ecosystem. The results determined by this study will be of help to environmental managers who need information about these point of river aquatic ecosystems.

Material and Method

This study is realized through a method divided in two main stages:

The preparatory stage

The data in this field are realized in the laboratory of the hydrological enterprise in Tirana. These physical-chemical and bacteriological data on these water sources were carried out in December 2020

Field work phase

At this stage, water sample was carried out in the period December 2020- May 2023. Their analysis is made by me, near a private environmental laboratory in Elbasan according to the methods:

Determination of nitrates, determination of dissolved oxygen - iodometric method, Alkalinity. Water quality - Enumeration of culturable micro-organisms - Colony count by inoculation in a nutrient agar culture.

Results and Discussion

In our study according to the physical-chemical analysis data: Water resources are of the phreatic type, with general temperatures of 16.3 degrees Celsius. The water is without cooler, small and taste. The valoris of anion NO_3 and phosphorus appears very low. Ph 8.3. With a strength of 28 degrees German, mineralization is too high 160mg/l.

The current physical-chemical data are presented in this comparative Table 1.

Table 1. The current physical-chemical data are presented in the comparative graphic

Station name	Sampled period	Mg (mg/L)	NH4 (mg/L)	P tot (mg/L)	Do (mg/L)	Ph	Strength G Degrees	The value of quality
Vidhas-Shkumbin River Elbasan	December 2020	35	0.1	-	12	8.6	23	1
Vidhas-Shkumbin River Elbasan	May 2023	45	1.2	0.11	8.7	8.5	28	2.2

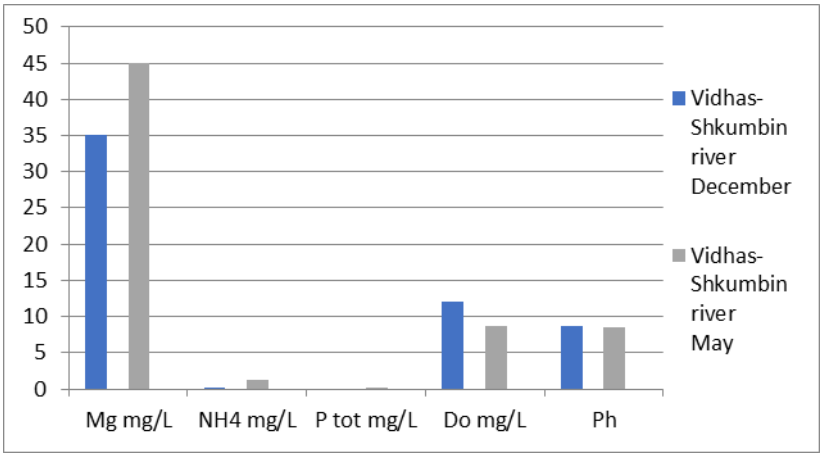

Figure 1. Physical-chemical Data (2020-2023)

Based on the presence of bacteria E.coli, Pseudomonas aeruginosa, Enterococci intestinal. The bacteriological content the water appears mostly high.

The current physical-chemical data are presented in this comparative Table 2.

Table 2. Physical-chemical data

Station name	Sampled period	E. Coli	Pseudomonas aeruginosa	Enterococci intestinal	Colony count at 22 Degrees	Allowed rate
Vidhas-Shkumbin River Elbasan	December 2020	80	50	70	63	100 ml
Vidhas-Shkumbin	May 2023	250	110	150	110	100 ml

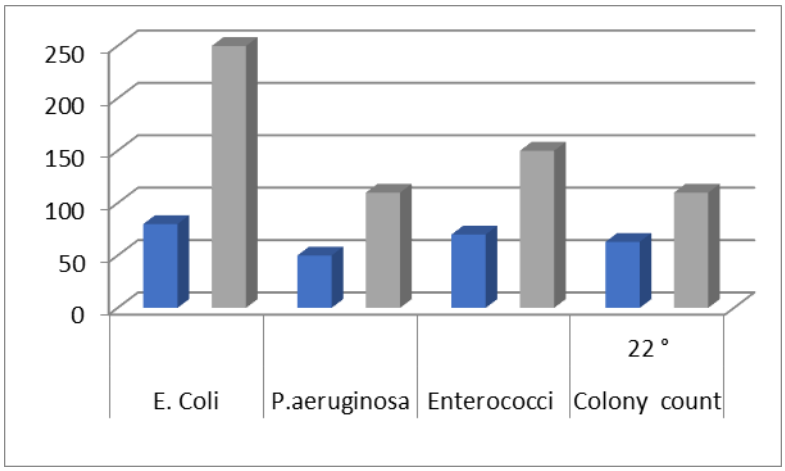

Figure 2. Comparative graphic of Bacteriological Data (2020-2023)

Conclusion

Compared to the 2020 data study, we see a decrease of 0.5 in water quality. As point of the threshold ecology will be the presence of the E.coli and Pseudomonas aeruginosa. That's a sign of a high presence pollution of black waters. According to Italian law and analysis: These Water resources are classified as a Type 1. To prevent the transition from a clean aquatic ecosystem to a turbid aquatic ecosystem. These water resource need a simple processing, filtration and disinfection.

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Statistical properties of image pixel brightness from the onboard optical system

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Cite this study: Solonar, A. S., Tsuprik, S. V. & Khmarskiy, P. A. (2023). Statistical properties of image pixel brightness from the onboard optical system. Advanced Engineering Days, 7, 172-174

Keywords
Image processing
Unmanned aerial vehicle
Optical location system
Image pixel brightness

Abstract

The research of statistical properties of image pixel brightness has been carried out, allowing us to improve the quality of the choice of the required mathematical model. The results of the analysis of ground-based background-target videos obtained by an unmanned aerial vehicle's onboard optical-location system are presented. The requirements to the mathematical model of brightness in the ground-based noise-target environment is formulated.

Introduction

Many domestic and foreign publications are devoted to the effective use of information obtained from the onboard optical locating system (OLS) for the purpose of tracking ground objects [1-9]. Such objects include civil and military ground transport, people, infrastructure objects and others. At the same time, the problems of tracking in OLS are exacerbated by observation of objects on a complex and heterogeneous background (pavement, landscape, vegetation, other ground objects). Also, for ground-based background-target situation, the presence of a large number of objects in the radar frame at the same time is characteristic, which complicates the task of tracking in manual mode by the operator. In case of a multi-target situation, an effective solution is to automate the process of ground object tracking based on onboard radar data. Most often, the automation process is realized by means of several well-known approaches, based on image contour analysis, selection of reference (reference) points, extremal-correlation analysis, as well as application of neural network algorithms [1, 2, 6, 7]. However, the issue of their effective application in ground-based background-targeting conditions remain relevant, due to the great diversity of the obtained images. In turn, the diversity has led to a number of generally accepted mathematical models of images [2, 6]. The work presents the research of statistical properties of image pixel brightness, allowing us to choose a mathematical model with the highest degree of adequacy. The results of the analysis of video recordings of ground background-target conditions obtained by the airborne optical-location system are presented, allowing us to put requirements to the selected mathematical model.

Material and Method

We have developed a methodology for investigating statistical properties of brightness, which consists of the following stages: formation of a data bank containing similar video recordings for given observation conditions; extraction of images belonging to the objects of interest from the data bank. Formation of pixel brightness slices; estimation of the law and numerical parameters of image brightness distribution by histogram method; analysis of individual pixel brightness distributions, construction and analysis of autocorrelation functions (ACF); estimation of dynamic stability of image pixel brightness (estimation of stationarity). To conduct research in accordance with the stated methodology, developed a software package of experimental studies, the block diagram of which is shown in Figure 1.

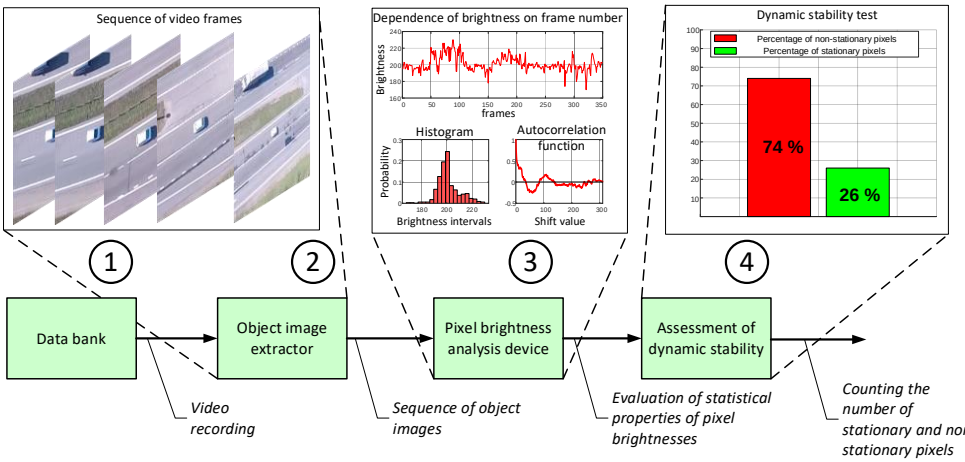
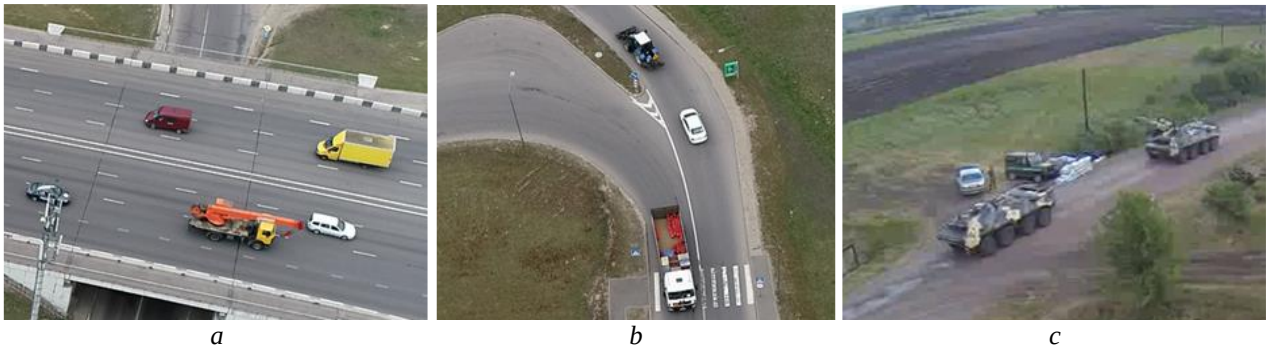


Figure 1. The structural scheme of the program complex of experimental research

Results and discussion

The input data for the experimental studies are video recordings obtained by the onboard OLS. The recordings show moving ground vehicles, both military and civilian (Figure 2). The footage was recorded during daylight hours with good visibility and no interfering factors (rain, snow, fog, etc.). Recording was performed with a resolution of 1920×1080 pixels and 29 frames per second.



a *b* *c*

Figure 2. Conditions of ground objects observation according to onboard radar data: a, b - civilian vehicles on the highway; c - military vehicles on the march

The data bank of the images of the objects, consisting of 18 records, was formed. The total size of the analyzed sample was more than 100000 brightness counts. The sizes of images of objects are fixed and were 32x32 pixels. In this case it is considered, that in the process of observation the sizes of images of objects remain invariable. Objects are observed from different angles due to their own movement, UAV movement and rotation of the OLS. The background has a complex structure, as it includes various elements, such as the road with markings, areas of vegetation, as well as other passing cars. It is considered that a part of background pixels belongs to images of objects and constitutes no more than 10% of the total number of pixels.

Then we analyzed the distribution of pixel brightness's and their correlation properties according to the brightness slices (Figure 3a). The analysis of the distribution was carried out by the histogram method. The number of grouping intervals for histograms was 50. The histograms obtained show that the pixel and image brightness distributions have a multimode character, which means that the distribution parameters change during the observation process. Basically, the changes in the distribution parameters are due to changes in the orientation of the observed object in space, which leads to distortion of its image.

To assess the correlation relationships between the brightness values at different moments of time, we analyzed the ACF of image brightness for all pixels over the entire observation interval. Analyzing the shape of the ACF, we can conclude that it can be approximated by the exponential correlation function. However, for each individual pixel the correlation time can differ significantly. Therefore, to approximate the exponential ACF the correlation time should be chosen as an average for all pixels of the image.

Changes in the distribution parameters indicate the non-stationarity of the observed process. In order to confirm this hypothesis, the dynamic stability of the ACF was evaluated. The results are shown in Figure 3b. The graph shows that 74% of the pixels of the images composing the data bank are non-stationary, which is significantly higher than the allowable percentage determined by the research methodology. The estimation of the duration of the stationarity intervals is shown in Figure 3b. The obtained estimation of the distribution indicates a high degree of compliance with the indicative law. To assess the degree of compliance we used well-known

statistical Pearson's chi-square test of agreement. As a result, it is established that the obtained distribution of stationarity intervals with confidence probability not less than 0.9 corresponds to the exponential law. Correspondence of time intervals durations to the exponential law indicates that the process of brightness change in time can be obtained by means of Markov sequence model with continuous time set by Poisson flow of events.

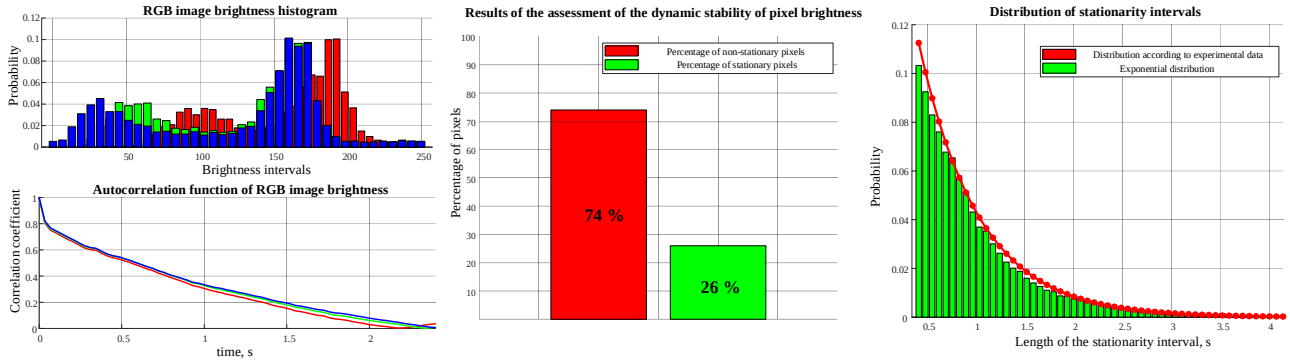


Figure 3. Brightness histograms, autocorrelation function of ground object image brightness in three RGB color channels, as well as the results of estimation of dynamic stability and distribution of pixel brightness stationarity intervals

Conclusion

Thus, in accordance with the proposed research methodology of statistical properties of pixel brightness of images formed by airborne radar, the mathematical model of pixel brightness belonging to the image of a ground object must have the following properties: the law of pixel brightness distribution is unknown and has a multi-mode structure; process of brightness change in time is predominantly non-stationary (74 %) and has properties of dynamic system, which parameters change in time; the durations of stationarity intervals are distributed according to the exponential law, and the change of states occurs at random moments of time according to the Poisson law; the autocorrelation properties of brightness in time can be described by ACF of exponential form, the correlation time of which corresponds to the average value of correlation time in each pixel of object image.

Research was carried out with the support of a grant from the Belarusian Republican Foundation for Fundamental Research (project No. F23M-103).

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Studies on the extraction of oil from watermelon seeds

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Cite this study: Boykharayevich, F. J. (2023). Studies on the extraction of oil from watermelon seeds. Advanced Engineering Days, 7, 175-177

Keywords
Cold pressing
Watermelon seeds
Seed kernels
Seed peels
Watermelon seed oil

Abstract

In this work, the results obtained show that in order to obtain the maximum amount of oil from watermelon seeds, it is necessary to add 5% of the seed shell to the seed kernel, steam at 150 °C for 20 minutes and dry the mixture. At the same time, the fat yield is 13.59%, and the cake is 69.19%.

Introduction

At a time when the country is undergoing deep reforms in the agricultural sector, the implementation of the process of production and consumption of organic products can give the desired result. It should be noted that the processing of non-traditional oilseeds mentioned above gives not only medicinal organic oils, but also kunjara, which contains biologically active substances necessary for the human body: proteins, lipids, minerals, vitamins and very nutritious, fragrant and healing. There are substances with properties based on which the nutritional composition of the population is enriched with natural substances. The use of this type of unconventional raw materials in the production of new types of vegetable oils, raw materials for pharmaceuticals, as well as in the production of spreads, mayonnaise and bread, pastries, confectionery is highly effective [1].

It requires the study and analysis of production technology. Based on the above, in our study, along with the study of local types of fatty raw materials grown in the Republic. At the same time, we strive to study and improve oil extraction technologies or technological processes, processing them in accordance with the structure of non-traditional oilseeds, thereby producing functional types of oilseeds. The main goal of our economy in the future is to get the maximum.

Currently, due to the lack of fresh water and the reduction of acreage, the problem of providing the population with food is sharply aggravated. In this regard, the intensification of technological processes, increasing the yield of products and improving quality, including the processing of raw materials for medical purposes and healthy nutrition, the production of oils rich in polyunsaturated fatty acids is becoming relevant [2-3].

In the world, special attention is paid to obtaining oil from seeds of stone fruits, crushed melon seeds, wheat germ, pine nuts. At the same time, research work to determine the impact of the use of trace elements and vitamins, the production of essential polyunsaturated fatty acids, increasing thermal stability using ultrahigh frequencies and electromagnetic fields on human health are important [4-5].

Material and methods

The research was carried out on the seeds of the Dakar watermelon variety with an oil content of 20.10%. Chemical analysis of the initial, intermediate and final products was carried out by known methods [7-12].

The oil content of seeds is understood as the content of raw fat in them and the fat-like substances accompanying it, which pass together with the fat into the ether extract from the seeds under study.

The method for determining moisture and volatile substances applies to oilseeds, cake, meal and establishes a near-infrared spectroscopy method for simultaneous determination of the following quality indicators:

- the mass fraction of fat (in the measurement range from 1% to 60%);
- the mass fraction of moisture and volatile substances (in the measurement range from 1% to 18%);
- protein mass fraction (in the measurement range from 5% to 80%);
- the mass fraction of fiber (in the measurement range from 2% to 50%).

Results and Discussion

Due to the fact that studies on the production of oil have not been carried out before, the process of direct cold pressing of watermelon seeds, with preliminary heat treatment of seeds and cold pressing of the core of watermelon seeds after crushing and separating the peel, was studied. Under these conditions, it is not possible to extract oil from watermelon seeds. An insignificant amount of 9.07% oil was isolated during cold pressing of crushed seeds without separating the peel.

Therefore, the effect of the amount of watermelon seed peel on the yield of oil and cake after steam treatment was further investigated. To do this, 200 g of watermelon seeds were divided into a core and a peel, 5, 20 and 100% of the peel were added to the selected amount of seed kernels, steamed at 150 ° C for 20 minutes, dried at 80, 90 and 100 ° C for 25 minutes and subjected to cold pressing. The results obtained are shown in Table 1.

Table 1. The effect of pre-heat treatment on oil extraction and the yield of cake from the core of watermelon seeds

№	Introduced peel (%)	Steam treatment time (min)	Weight gain after heat treatment (%)	Drying time (min)	Drying temperature (°C)	Cake output (%)	Oil output (%)
1	5	20	6	25	80	69,19	13,59
2	20	20	6	25	90	78,14	12,72
3	100	20	6	25	100	94,9	11,10

From the data obtained, it can be seen that after steam treatment of a mixture of the kernel and the peel of watermelon seeds, regardless of the amount of peel added to the kernels, the mass of the mixture increases by 6%. At the same time, the oil yield with an increase in the amount of the introduced peel from 5% to 20% and 100% decreases from 13.59% to 12.72% and to 11.10%, respectively. The yield of cake under these conditions increases from 69.19% to 78.14% and to 94.90%.

The obtained results indicate that in order to obtain the maximum amount of oil from watermelon seeds, it is necessary to add 5% of the seed peel to the seed kernel, steam it at a temperature of 150 ° C for 20 minutes, dry the mixture at a temperature of 80 ° C for 25 minutes and subject to cold pressing. At the same time, the oil yield will be 13.59% and the cake 69.19% of the available amount.

Increasing the duration of the sesame seed treatment process increases the oil yield from the first minutes. So, when processed for 3 minutes, the oil yield increases by 8.49% and increases from 18.61% to 27.10%. The maximum degree of oil extraction is observed during processing for 10-15 minutes and is 31.55-32.79%. A further increase in the processing time to 20 minutes leads to a decrease in oil yield up to 24.08%.

Under optimal conditions of processing duration of 10-15 minutes, the yield of cake is the smallest and amounts to 68.20-66.71%.

Conclusion

Thus, the maximum amount of watermelon seed oil must be added to the seed kernel 5% of the seed peel, steamed at 150 °C for 20 minutes, the mixture dried at 80 ° C for 25 minutes and subjected to cold pressing. At the same time, the oil yield will be 13.59% and the cake 69.19% of the available amount.

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The role of education in cyber hygiene

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Cite this study: Basholli, A., Mema, B., Basholli, F., Hyka, D., & Salillari, D. (2023). The role of education in cyber hygiene. Advanced engineering Days, 7, 178-181

Keywords
Cyber hygiene
Education
Identification
Prevention
Cooperation

Abstract

In recent years, societies around the world have made great strides in the field of information and communication technology. Albania ranks among the countries where the development of technology, access to the Internet and the computerization of society progresses very quickly. Today, the e-albania government portal offers 1225 online services for citizens and businesses. In this framework, information security is paramount in modern cyber defense and an important factor related to the reduction of security breaches influenced by people by being included under a new concept, "cyber hygiene". This concept focuses on how we can protect ourselves from online risks and threats and how we can use technology in a safe and sensible way. Using a combination of available resources and a review of field studies, this article addresses and defines the importance of proper preparation and awareness of users to deal with risks and threats in their online operations. The results of this analysis will be based on the processing of surveys carried out in three public university faculties and two engineering departments in private universities, from which we conclude that education in cyber hygiene is the basis for promoting the safe and reasonable use of technology, improving in the continuation of the curricula of courses with object from the sciences of information technology.

Introduction

While attacks and data leaks are present, the increase in human or financial resources allocated to cyber security and the prosecution of computer crimes has not definitively prevented these interventions. According to some observations that we organized in the first five months of this year, it is observed that this uncertainty is due to deficiencies in cyber education and that human error is the main cause for violations of personal data and secure information [1]. In this article we will talk about the increasing use of technology and the importance of cyber hygiene as a current challenge in the modern world and we will give a general concern about internet security and the impact on our daily lives. By analyzing some of the most common risks and threats on the Internet, such as virus attacks, malware, phishing and data leaks, we aim to show users how these threats can cause damage and, most importantly, how to prevent them [2]. To examine the importance of cyber hygiene education, where there are several "human factors" that increase or decrease the likelihood of being a victim of a cyber attack, hack or data breach, and even being victimized multiple times, we will emphasize the advantages of a responsible and genuine education in the security and protection of personal data. Successful cyber hygiene education methods and strategies include interventions by responsible government structures, educational institutions, non-governmental organizations and the community at large. The treatment will contain recommendations for elements such as suitable curricula, specialized training for Internet users, awareness campaigns and the increase of public-private partnership. Next steps and challenges in cyber hygiene education will include recommendations for the development of education and training programs, as well as for the creation of policies and legislation that promote Internet safety [3]. Cyber hygiene is certainly important in maintaining cyber security, but it is not necessarily synonymous with cyber security. While cyber security is the

objective measurement of behaviors taken to maintain security and strengthen defenses against cyber-attacks, cyber hygiene relates to internet security knowledge and practices related to further enhancing cyber security. In conclusion, to improve cyber security, we need to improve cyber education.

Material and Methods

The material and methods are based on an analysis of available and specialized sources in cyber security such as the National Authority for Electronic Certification and Cyber Security (AKCESK) and the observation of teaching programs, curricula, literature to identify important data and the latest in the field of education and cyber hygiene in several public and private engineering departments and faculties.

a) Detection of cyber intrusions

From the monitoring of several state institutions and Internet Service Providers (ISPs) operating in Albania, which generate malware with a source in Albania and destination in different countries, the following data extracted from this monitoring are evident [4-6]. Below are the corresponding tables and graphs for two institutions and for four ISPs, identifying them with institution 1 and institution 2, as well as the ISPs, with ISP-1 to ISP-4.

Table 1. The number of malwares generated in the months of May-June 2021

The year 2021	Number of Malware		Number of Malware			
Months	Institution-1	Institution-2	ISP-1	ISP-2	ISP-3	ISP-4
May	882	1286	17109	85759	15494	73210
June	1155	1078	21256	89745	15135	1792
July	334	1771	19358	87572	7171	114
August	109	115	11200	50322	3785	326
September	135	261	11154	38159	416	410
October	178	193	16516	54494	60	796
November	100	250	15431	47861	51	912
December	148	267	15360	38613	52	892

b) Penalties for computer crimes consist of the following aspects:

• Computer fraud - Entering, changing, deleting or removing computer data or interfering with the operation of a computer system, with the aim of providing oneself or third parties, by fraud, with an unfair economic benefit or causing them a third decrease in wealth [7- 8].
• Unauthorized computer access - Unauthorized access or in excess of authorization to access a computer system or a part of it, through the violation of security measures.
• Illegal interception of computer data - Illegal interception by technical means of non-public transmissions of computer data from/or within a computer system, including electromagnetic emissions from a computer system, which carries such computer data.
• Interference in computer data.
• Misuse of equipment - Manufacturing, keeping, selling, providing for use, distribution or any other action, for making available a device, including a computer program, a computer password, an access code or such data similar, which are designed or adapted for access to a computer system or a part thereof [9-11].

Table 2. Computer Crime and Criminal offense in the field of Information Technology

Categories of crimes	Month and year					
	January 2018	January 2019	January 2020	January 2021	December 2021	January 2022
In the field of IT	6	10	14	17	25	14
Through the computer system	7	5	8	17	30	21
Number of Cyber Crimes	13	15	22	34	55	35

c) Education in the field of Information Technology

Where we include knowledge about Information Technology, cyber security, therefore Cyber Hygiene. While online safety guidelines for students, college students, and consumers are available free of charge, it is worth considering how many users read and understand these reports and whether these safety guidelines are written in language that can be understood by the general consumer. and literate, as well as for those left behind with current technology [12]. Through the table below, we can understand the educational gap in cyber security, and the need for mandatory cyber hygiene education for all individuals, including professions that use information

technology as a basis for their work [13]. Extract from the Bachelor study program, in the Engineering Departments at the University A, B, C, D, E in Table 3.

Table 3. Extract from the Bachelor study program

Training subjects for Information Technology, which contain university curricula (Bachelor)	Credits	Amount of hours	The percentage that occupies the educational program
Engineering software	5	68	2.8 %
Architecture of control systems	5	64	2.8 %
PLC, Programmable automata	5	60	2.8 %
Informatics	5	67	2.8 %
Information and communication technology	5	45	2.8 %
Basic elements of informatics	5	61	2.8 %
Computer architecture	4	42	2.2 %
Theory of computer networks	5	60	2.8 %
Database	9	110	5.0 %
Electronic calculators	6	60	3.3 %

Results and Discussions

From the analysis of Table-1, "Discovery of cyber intrusions", Table-2 "Penalties for criminal offenses on Computer Crime" and Table-3 on "Education in the field of Information Technology" is easy to conclude in deepening our understanding of the importance of education in cyber hygiene and providing sustainable recommendations to improve existing programs, policies and practices [14]. These statistics can be used as a basis for the development of future strategies and the implementation of cyber hygiene policies at local, national and wider levels. To positively impact safety and security in the cyber world, we must invest in user education, raise awareness and promote safe practices. Only through joint efforts and continuous improvements in the field of education and cyber security, we can build a reliable and safe environment for all Internet users [15]. Our responsibility as individuals, institutions and society is to improve our awareness, build our capacities and create a culture of security and awareness in the cyber world. Internet users should understand that everyone has personal responsibility for their own online safety. They should be encouraged to learn and implement security practices, cultivate awareness, and share cyber hygiene information with others [16]. In conclusion, improving cyber hygiene education is a shared task for all. Only through broad engagement and cooperation can we build a safe and reliable cyber environment for all users. Cyber challenges know no boundaries. It is important to develop international cooperation in the fight against cyber threats and to improve education in cyber hygiene. This includes the exchange of knowledge, experiences and good practices with other countries, as well as the development of common standards and policies for cyber security [17]. It is important to develop suitable and easy-to-use educational materials for all age groups. These materials should be clear, straightforward, and address online risks and safe practices. They can be in the form of books, brochures, video tutorials and mobile applications. Education in cyber hygiene should not be a prescribed process, but should be an ongoing effort. Educational institutions, non-governmental organizations and technology companies should provide continuous education and training programs to keep users informed and up-to-date with developments in the cyber field [18].

Conclusion

- ✓ School curricula should include more information and activities related to cyber hygiene. This can be done through the creation of separate modules or through the integration of cyber hygiene into existing subjects such as informatics, control systems architecture, computer architecture and community service education.
- ✓ It is important to monitor and evaluate the effectiveness of cyber hygiene education programs. This can be done through the assessment of user knowledge and behavior, identification of new challenges and needs, as well as through the analysis of cyber security statistics and data.
- ✓ Educational institutions and non-governmental organizations can organize clubs and interest groups dedicated to cyber hygiene. These forums can provide opportunities for discussion, specialized training, exchange of experiences, and the development of joint projects that address Internet security issues.
- ✓ Technology industries have an important role to play in improving cyber hygiene. Educational institutions and organizations should collaborate with these companies to develop innovative educational materials, secure applications, technology tools and platforms that help educate users about online safety and security.
- ✓ Collaboration between the public and private sectors can strengthen cyber hygiene education efforts. Partnerships can bring added resources, different expertise and opportunities to implement joint education and awareness programs.

- ✓ The development of advanced tools and technologies can help improve cyber hygiene education. The use of technologies such as artificial intelligence, mixed reality and data analytics can improve teaching and make cyber training more engaging and effective.

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Obtaining and testing results of PF-1 brand corrosion inhibitor obtained based on the processing of chlorinated organic waste used in the oil and gas industry

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Cite this study: Ugli, K. J. A., Nurmuminovich, N. F., & Turapovich, D. A. (2023). Obtaining and testing results of PF-1 brand corrosion inhibitor obtained based on the processing of chlorinated organic waste used in the oil and gas industry. Advanced Engineering Days, 7, 182-184

Keywords
Corrosion inhibitors
Nitrogen
Organic compounds
Fatty acids
Gas-condensate well

Abstract

The article examines the physical and chemical properties of corrosion inhibitors obtained on the basis of the processing of organochlorine waste for the oil and gas industry. Corrosion inhibitors of metals were obtained as a result of the synthesis and their level of protection was checked. The results of IR spectra were studied.

Introduction

In the global production of corrosion inhibitors composed of organic compounds, hydrocarbon-soluble inhibitors account for about 30% of the volume, the largest part of which (~70%) is used in oil refining Corrosion of these metal-based materials has a large economic impact. According to a recent study by NACE, the total economic loss to the environment due to corrosion is USD 2.5 trillion, which is equivalent to 3.4% of world GDP [1].

In most cases, the recommended inhibitors are organic compounds of various classes containing heteroatoms: nitrogen, sulfur, oxygen, and phosphorus. The effectiveness of the inhibitory effect of substances increases in the series of heteroatoms: O ^ N ^ S ^ P. However, since the toxicity of products also increases in this series, nitrogen-containing compounds are usually chosen for industrial use. Although it is less effective than compounds containing sulfur or phosphorus, they are a less toxic compound [2].

Corrosion inhibitors are chemicals that are injected into the well in various ways to protect the casing from internal corrosion caused by the produced fluid. It should be noted that some operators further protect parts of upstream structures after the wellhead by choosing the appropriate type and dosage of inhibitors injected into the wells.

Material and Method

Our researched PF-1 brand corrosion inhibitor was tested by gravimetric method. This method is used to determine the corrosion rate for corrosion control purposes and to evaluate the protective ability of corrosion inhibitors. The gravimetric method is based on measuring the difference in the mass of control metal samples before and after exposure to a corrosive environment. A limitation of the use of this method is that it characterizes the average corrosion rate without taking into account the unevenness of the corrosion.

In general, when working, it is necessary to follow the current standard GOST 9.506-87 "Methods for determining the protective ability of metal corrosion inhibitors in water-oil environment".

According to it, the product based on amino compounds and fatty acids obtained from the treatment of organochlorine waste is first put into a three-necked flask equipped with a reflux condenser, a thermometer and a stirrer for interaction, and a homogeneous mass is formed. mix until Stirring was continued at a certain temperature for several hours. The obtained corrosion inhibitor was dissolved in gasoline, condensate, and motor oil media at concentrations of 1%, 3%, and 5%. Many studies have been conducted on the resulting solutions.

IR spectrum and analysis of PF-1 brand corrosion inhibitor. The IR-spectrum was presented to study the composition and structure of the PF-1 corrosion protection inhibitor that we synthesized and used in the test (Figure 1).

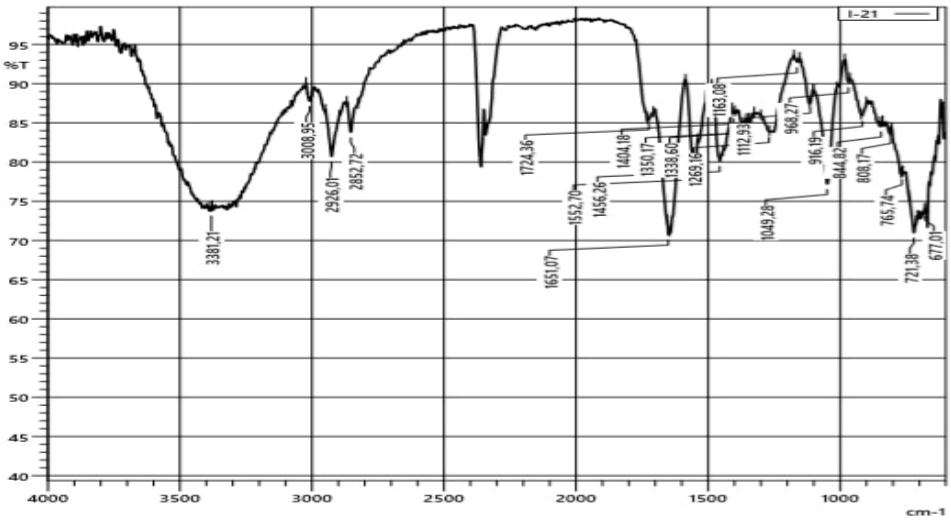

Figure 1. IR spectrum of PF-1 brand corrosion inhibitor

The composition and structure of PF-1 corrosion inhibitor was studied using IR-spectrometer technology (IK-Fure, SHIMADZU, Japan) in the range up to 4000 cm-1. The spectrum of the –N=C< groups produces valence vibrations in the region of 1651.07 cm-1 and in addition 1552.7 cm-1 –NH2 in the structure. >N-CH2 in 1350.17 cm-1 and valence fields 844.82 – 808.17 cm-1 contain absorption lines corresponding to -CH2-CH2- groups in the aromatic ring.

According to the results of this analysis, our researched corrosion inhibitor contains nitrogen, which shows that it has anti-corrosion properties.

Results and Discussion

Properties of nitrogen-containing oil-soluble corrosion inhibitors were studied by the test method according to GOST 9.506-87. The molecules of these corrosion inhibitors consist of one or more functional groups that are organic substances containing a hydrocarbon radical. Tests have been conducted

3 different concentrations for 72 hours in a test rig at atmospheric pressure. The test time is calculated from the moment the samples are placed in the environment. The duration of the tests was determined according to GOST 9.905 82. Tests were conducted in gasoline and condensate environments.

The concentration of PF-1 brand corrosion inhibitor containing nitrogen and phosphorus is 1% 3% 6%; ; It was carried out in a condensate environment. As a result of the tests, the level of protection was 81.1, 89, 98.5 percent, respectively. With the help of the graph below, the levels of protection of our corrosion inhibitor at different temperatures are presented.

The Table 1 shows corrosion rates and protection levels in inhibited and uninhibited environments.

Table 1. Test results of PF-1 brand corrosion inhibitor

Model number	Sample Surface S, m^2	Mass of the sample before the test M, g	Mass of the sample after the test M, g	Sample mass loss, M_1-M_2, g	Vn.i Corrosion rate in medium without inhibitor,g/ m^2*s	Vi Corrosion rate in an inhibitory medium, g/ m^2*s	Protection level (Z)%
1	2	3	4	5	6	7	8
Without an inhibitor	0,005	0,41243	0,38412	0,02831	0,07863	-	-
1%	0,005	0,40389	0,39853	0,00536	-	0,0148	81,1
3%	0,005	0,43408	0,4312	0,00288	-	0,08	89
6%	0,005	0,41933	0,4181	0,00123	-	0,00341	98,5

As a result of the test research, we can see with the help of table 1 that the best mass ratio of amine compounds and fatty acid is 1:2, and the level of protection in it is 89%.

Conclusion

The physicochemical properties of the PF-1 brand corrosion inhibitor synthesized by us and the analysis of the IR spectrum of the synthesized product were obtained. As a result of the analysis, it was found that this inhibitor contains nitrogen. These compounds have been found to be the most effective against corrosion.

Also, the obtained inhibitor was tested in different environments, at different mass ratios and temperatures. The PF-1 brand corrosion inhibitor, obtained as a result of the processing of organochlorine waste, containing nitrogen, was carried out in a condensate medium with a concentration of 1%, 3%, and 6%. As a result of the tests, the level of protection was 83.3, 90.6, 98.6 percent, respectively. Our researched and tested PF-1 corrosion inhibitor can be used in various pipelines in the oil and gas industry in various aggressive environments.

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Security in the components of information systems

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Cite this study: Basholli, F., Mezini, R., & Basholli, A. (2023). Security in the components of information systems. Advanced Engineering Days, 7, 185-187

Keywords
Systems
Technology
Integrity
Security
Information

Abstract

The security aspects of information systems in the public and private sector are very important, because these are often part of critical national security infrastructures. Although the size of the public sector varies in different countries, it usually includes all government infrastructure and various levels of local government, which consist of many smaller organizations scattered throughout the country. Today, even in the private sector, is being invested in the use of technology and security aspects. The purpose of this paper is about the processes, policies, procedures, and other documents that public and private sector organizations possess and use in the field of security and information systems. Through this paper, I think we contribute to understanding how these institutions or private companies stand against national and international standards and best practices in the field of security of components in information systems.

Introduction

We emphasize that information systems planning, development, operation and management by organizations and sectors takes place in a very specific context that presents special challenges. Institutions, public and private sector organizations are often tasked with procurement, employment, property management, remuneration procedures with inflexible salaries and operate within an institutional framework that is not easily changeable. These factors contribute to a variety of issues and difficulties related to the security of information systems components. Today, even in the private sector, is being invested a lot in the use of information technology, where personnel enjoy the advantages offered by technology in performing their daily work. Confidential information, company technology secrets, financial data, computer equipment and security issues are at risk if security procedures are not followed properly. The main responsibility of each user includes the data security and the telecommunications network used. The paper aims to address some other aspects in the field of information security, focusing on the issues of physical security of the facilities where these organizations operate, bearing in mind the possible limitations in human and financial resources [1-3].

Material and Method

Reviewing the literature related to the concept of information security, the history of security and its principles, we keep in mind:

The concept of Information Security, which includes the application of measures to ensure the security and privacy of data by managing their storage and distribution. Information security has both technical and social implications. Information security system is the process of data protection from unauthorized access, disclosure, or destruction [4-5]. The history of Information Security begins with security in telecommunication networks. The need for information systems security, i.e., the need to secure physical sites from threats, hardware, and software, was addressed as early as World War II, when the first analog computers (mainframes), developed to help in the calculations for breaking communication codes, were used. Access to sensitive military sites and security facilities

is initially controlled by means of personal cards, keys and facial recognition of personnel authorized by security personnel. The growing need to maintain national security eventually led to more complex and sophisticated defense measures utilizing today's technological advances [6-7]. The principles of Information Security, the CIA triangle, can be found in almost every security book today. The CIA triangle (**c**onfidentiality, **i**ntegrity, and **a**vailability) is useful in helping people think about security in direction of the most important aspects of information protection. The CIA concept is not perfect. The CIA focuses on three aspects of information protection that really are important, but this is not a comprehensive model. Alternatives to the CIA triad that include other aspects of security have been proposed by dissenters in the security profession (Figure 1).

Figure 1. The triangle CIA (**C**onfidentiality, **I**ntegrity, and **A**vailability)

The purpose of security in the components of information systems is to prevent unauthorized access (confidentiality) or modification (integrity) of data while maintaining access (availability). From this we conclude that the value of information consists of the characteristics it has. When a characteristic of information changes, the value of this information either increases or decreases. Some characteristics affect the value of information to users more than others. Confidentiality refers to restricting access to data only to those who are authorized to use it. In general, this means that a single set of data is accessible to one or more authorized people or systems, and no one else can see it [8-10]. Integrity means that the information is useful and reliable only if it is correct and has not been modified without the author's consent and approval. "Integrity" must be adequately protected by means such as appropriate authentication, routing protocols, proper configuration of systems and application security. ISO 27000 - ISO 27006 refers to integrity as the ability to maintain the accuracy and completeness of assets (data). Availability has to do with the systems (place) where the database is stored, on disk or more recently in the cloud. The rapid developments in information technology, the speed of decision-making is important, where the availability of important information at any time has become very necessary. Unlike confidentiality and integrity, which deal with the context of the data contained in computer systems, availability refers keeping the service of computer information technology systems functioning by ensuring that the service will be available when it is needed. Availability is one area where developments in technology have significantly increased the challenges for information security professionals.

Results and Discussions

Information systems are collections of interrelated elements that work together for a specific purpose. Information systems (IS) are defined as a set of interrelated components that work together to perform input, processing, output, storage, and control operations to obtain information from data conversion, which can be used to support forecasting, planning, control, coordination, decision-making and operational activities in an institution or facility. Hardware and software are usually mentioned as part of information systems, but apart from these there are also other important components. The software component of includes applications, operating systems, and various software tools. Software is probably the most difficult component to secure. Exploiting errors made during software programming constitutes a significant part of information attacks. Hardware is the physical technology that carries and executes software, stores, and transports data, and provides the means for inputting and outputting information from the system. Physical insurance policies deal with hardware as a physical asset and with the protection of physical assets from damage or theft [11]. The application of traditional physical security tools, such as locks and keys, restrict access and interaction with the hardware components of an information system. Securing the physical location of computers and securing the computers themselves is important because a breach of physical security can result in information loss. Hardware components have always played a major role in computer security. Over the years, this role has grown exponentially, due to increased processing power, communication capacities and capabilities, as well as decreased cost and component size. Inexpensive, powerful, easily accessible network devices present significant challenges to computer security. Data stored, processed, and transmitted by a computer system must be protected. Data is often the most valuable asset

possessed by an organization and is the main target of deliberate attacks. Another important aspect is data classification.

Information classification, related to information security, is about placing information into categories that indicate how this information should be handled in relation to access control and maintaining confidentiality. Although often overlooked in aspects of computer security, humans have always been a threat to information security. It is often thought that people can be the weakest link in an organization's information security system. The information security culture must support all activities so that information security becomes a natural aspect in the daily activities of every employee (user), that the development of the information security culture must result in changes in employee behavior. Developing information security culture can lead an employee to act as a kind of "human firewall" to protect organizational assets (information). This means that employees must perceive safety practices as part of their daily work routine. Without proper employee security perception, an organization will remain highly exposed to security threats and deficiencies. The information security procedures are instructions for carrying out a process. The computer networks are components of SI that are used by increasing computer and information security. The latest challenge has been created by the increasing popularity of wireless networks [12-13].

Conclusion

The organization of trainings with users of information technology equipment is an aspect that has room for significant improvement in the field of cyber hygiene, where risk management should be more than a simulated control exercise. Information security isn't something you buy, it is something you develop, and you must have talented people to do it right. Security in the components of information systems is a social responsibility. We all have a role to play. Trust in technology is a good thing, but controlling it is even better.

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