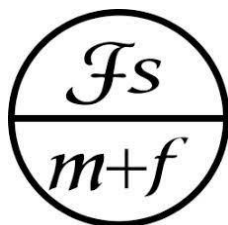


Towards Earth Resources: Sustainability

Proceedings of workshop TER2023

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Herľany, Slovakia



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of the Scientific Grant Agency of the Ministry of Education, Science, Research, and Sport
of the Slovak Republic and the Slovak Academy of Sciences.

Foreword

Dear participants of the workshop and other readers!

You are currently opening the booklet of abstracts from the event entitled *Towards Earth Resources: Sustainability* (TER2023). In 2021 we started a tradition of annual workshops dedicated to earth resources. The first one, *Towards Earth Resources* (TER2021) was subtitled *Challenges of the Automotive Industry*. Its success as well as a number of hitherto undiscussed topics related to earth resources encouraged us to organize the second volume of the workshop in 2022 entitled *Towards Earth Resources: Innovations* (TER2023). Hence, this year we are already opening the third chapter of our series of *Towards Earth Resources* workshops.

The aim of workshop of this year is to discuss current topics and issues related to sustainability and earth resources. The important is the presence of participants from the university and research environment as well as industry at this event. The small change in the present workshop is in its form. Although its hybrid form allows us to connect with some speakers online, we believe that meeting of workshop participants in person has its added value.

The workshop TER2023 is organized by the Slovak Society of Applied Cybernetics and Informatics (SSAKI) a member of the Association of Slovak Scientific and Technological Societies, namely, the branch office of SSAKI by the Institute of Control and Informatization of Production Processes (SSAKI URIVP) of the Faculty of Mining, Ecology, Process Control and Geotechnology of the Technical University of Košice, Košice, Slovakia. It is also co-organized by the Union of Slovak Mathematicians and Physicists which operates as a science unit at the Slovak Academy of Sciences.

On the behalf of organizers of the event, let me express the hope that you will enjoy the TER2023 workshop and that it will lead to fruitful discussions and results.

Erika Fecková Škrabuľáková - Editor

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Event Program

9:00 a.m. - 9:15 a.m.	Registration of participants
9:15 a.m. - 9:20 a.m.	Opening of the event
9:20 a.m. - 10:30 a.m.	1 st block of lectures
10:30 a.m. - 10:50 a.m.	Coffee break, refreshment
10:50 a.m. - 12:00 p.m.	2 nd block of lectures
12:00 p.m. - 1:00 p.m.	1 st problem section, brainstorming
1:00 p.m. - 2:00 p.m.	Lunch
2:00 p.m. - 3:10 p.m.	3 rd block of lectures
3:10 p.m. - 3:30 p.m.	Coffee break, refreshments
3:30 p.m. - 4:40 p.m.	4 th block of lectures
4:40 p.m. - 5:40 p.m.	2 nd problem section, brainstorming
5:40 p.m. - 5:50 p.m.	Closing of the event, summary, conclusions

Schedule of Lectures

1st block of lectures	
9:20 a.m. – 9:40 a.m.	Ždímalová M.: Sustainability of Technical Materials through Segmentation of Cracks in Materials
9:45 a.m. – 10:05 a.m.	Bogdanovská G. and Bednářová D.: Improving Material Flow Using the Kanban Method
10:10 a.m. – 10:30 a.m.	Drančák L.: On TensorFlow
Chairmen:	Matúš Fecko, Rebecca Frančáková

2nd block of lectures	
10:50 a.m. – 11:10 a.m.	Stehlík M.: Modern Methods of Computer and Voice Control
11:15 a.m. – 11:35 a.m.	Kopil M.: Design of Methodical Procedures and Recommendations for the Evacuation of People from the Cableway of Ski-park Erika
11:40 a.m. – 12:00 p.m.	Ivanová M. and Fecková Škrabuláková E.: On Sustainability of the Environment
Chairmen:	Andreas Volkov, Lukáš Vrtel'

1st problem section	
Chairmen:	Beáta Stehlíková, Veronika Szabóová

3rd block of lectures	
2:00 p.m. – 2:20 p.m.	Vrteř L.: About Selected Innovative Environmentally Friendly Solutions on the Agricultural Market
2:25 p.m. – 2:45 p.m.	Fecko M. and Feckov Škrabuřkov E.: On Reducing the Burden on Nature with Thermal Smog
2:50 p.m. – 3:10 p.m.	Szab M.: On Sustainable Future of Steel
Chairmen:	Radoslav Buřa, Jana řoltsz Matulov

4th block of lectures	
3:30 p.m. – 3:50 p.m.	Feckov Škrabuřkov E. and Ivanov M.: PCB Substances as an Environmental Burden of the Zempln Region
3:55 p.m. – 4:15 p.m.	Bednrov D. and Bogdanovsk G.: Process Analysis and Proposal of Measures to Increase the Quality of Compressor Production
4:20 p.m. – 4:40 p.m.	Stehlkov B.: Cluster Analysis for Verifying the Suitability of Indicators for Decision Tree Classification Method
Chairmen:	Igor Kubenk, Mria řdmalov

2nd problem section	
Chairmen:	Ladislav Drank, Matř Kopil

Abstracts of Contributions



Process Analysis and Proposal of Measures to Increase the Quality of Compressor Production

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The effort to keep improving the technologies used, increasing their efficiency and minimizing their impact on the environment is the part of the management of production processes in the most of the current production companies. The active use of tools and methods of the statistical process control contributes to the achievement of the above objectives. Based on the monitoring of the regulated characteristics, it is possible to assess the state of the process and subsequently to eliminate external influences with appropriate management interventions, and thus actively reducing the variability of the process. With a stable process, it is then possible to ensure that the output of the process is as close as possible to the desired (target) value with minimal deviations.

This contribution presents an analysis of the production process of compressors and condensing units.

The aim of the performed analyses was to identify the locations and causes of errors on the condensing units of production line. Subsequently, the goal was to propose and implement measures in order to reduce the number of non-conforming products on the designated production line. At the end, the effectiveness of corrective measures that were successfully implemented was evaluated, and thereby the increase of the quality and efficiency of the specific production process has been observed.

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Improving Material Flow Using the Kanban Method

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One of the conditions for an efficient company is the need to have satisfied customers. A satisfied customer also has the right product delivered, at the right time, in the right quantity, and with the right quality. This can only be achieved by managing the flow of material and information correctly.

One of the options is to apply Kanban method to the selected management process. This system can minimize work-in-progress, reduce inventory, save costs, provide flexibility, and aid Just-in-Time production.

When implementing the system, it is essential to know the processes in their entirety. A prerequisite for successful implementation is the existence of self-managing control circuits between consumption and production areas. Also, important is the use of the pull principle, the flexible deployment of personnel and operating resources, or the delegation of short-term control to production staff using Kanban cards. For a successful implementation of the system, the right conditions have to be created in the company, the rules have to be followed, and the staff has to be properly motivated and trained.

Acknowledgements: The authors acknowledge the Grant No. VEGA 1/0264/21 of the Scientific Grant Agency of the Ministry of Education, Science, Research, and Sport of the Slovak Republic and the Slovak Academy of Sciences.

On TensorFlow

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TensorFlow is a platform-independent, open-source software library that can be used for Machine learning and Deep Learning (AI) tasks. Google originally developed the software for internal use. The framework offers a wide range of applications and enables the creation of learning neural networks. It is characterized by good scalability and can be run on a variety of systems ranging from smartphones to clusters with many servers.

TensorFlow has now become a quasi-standard for deep learning and neural network programming. The so-called graph is the basic element for the TensorFlow function. A graph is an abstract representation of a mathematical problem using an oriented graph. A graph consists of edges and nodes that are connected to each other. The nodes represent mathematical operations and data in TensorFlow. Connecting the nodes creates a graph that provides a mathematical model for the neural network.

Thanks to the open-source license, developers are free to use the framework for any purpose. The spectrum of possible applications ranges from face search and speech recognition to various data prediction.

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On Reducing the Burden on Nature with Thermal Smog

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²Technical University of Košice, Košice, Slovakia

Recently, the issue of global warming resonates more and more strongly in the media. Many scientists tried to propose different strategies for improving or at least sustaining the current state. Several summits were held with the theme of finding a way to stop the increase in the average annual temperature. But all this is in vain, as long as these efforts remain only at the theoretical level and the impact of global warming will be more and more noticeable also in our regions.

In this contribution, we reflect on the possibilities of individual contributions to the solution of this problem. Specifically, we discuss the possibilities of using the recuperator in ordinary households.

Recuperation makes it possible to save a relatively large amount of energy. Modern vehicles and households use its principle. In this post, we will, therefore, focus on its possible use in older buildings.

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PCB Substances as an Environmental Burden of the Zemplín Region

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In this contribution, we deal with the environmental burden of the Zemplin region with polychlorinated biphenyls (PCB substances / PCBs). Despite the fact that the production of PCBs in Chemko Strážske was completed in 1984, their presence can be observed even today.

From 1959 until the end of their production here the produced amount of PCBs reached approximately 21,000 t. A part of PCB substances contaminated river Laborec, and thus also water reservoir Zemplínska šírava. The greatest pollution was recorded in the waste channel of the factory. According to the results of the Institute of Preventive and Clinical Medicine in Bratislava, at the turn of 1987/88, the value of PCB substances here ranged between 3,900 ng/l and 4,500 ng/l. 8-250 ng/l of PCBs was observed in the waters of Zemplínska šírava. In the case of bottom sediments, the values in the water reservoir ranged between 98 ng/g and 3,480 ng/g – see the results of Kočan published in [1] and [2]. According to Danielovič, Hecl and Mati [3] despite the fact that the content of PCB substances in the soils of the Zemplín region was relatively frequent in the years 1996-2001, the contamination of soils with an excessive content of PCBs had only a local character.

As the situation regarding PCB substances has not been resolved even at the present, the Košice Self-governing Region in cooperation with the Technical University of Košice (the Faculty of Mining, Ecology, Process Control and Geotechnologies and the Faculty of Mechanical Engineering), the Slovak Ornithological Society/BirdLife Slovakia, the company Kosit and the civil association EnviSlovakia, prepared the Zemplin LIFE Remedy project with the aim to eliminate this environmental burden.

References:

[1] Kočan, A. et al.: Chlórované aromatické zlúčeniny v ľudskom organizme z vybraných modelových oblastí Slovenskej republiky. Záverečná správa o plnení výskumného projektu za obdobie 1993 -1995 (Chlorinated aromatic compounds in the human body from selected model

regions of Slovakia. Final report on the implementation of the research project for the period 1993-1995). Bratislava: Institute of Preventive and Clinical Medicine, 1995a.

[2] Kočan, A. et al.: Zafaženie životného prostredia a ľudskej populácie v oblasti kontaminovanej polychlórovanými bifenyli. Správa za 2. rok riešenia (Burden of the environment and human population in the area contaminated with polychlorinated biphenyls. Report for the 2nd year of the research). Bratislava: Institute of Preventive and Clinical Medicine, 1995b.

[3] Danielovič, I., Hecl, J., and Mati, R.: Polychlórované bifenyly a ich obsah v životnom prostredí regiónu Zemplín (Polychlorinated biphenyls and their content in the environment of the Zemplín region). Košice: Košice Self-governing Region, 2009, ISBN 978-80-89417-03-2.

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On Sustainability of the Environment

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Extraction and processing of earth's resources should go hand in hand with sensitive monitoring and evaluation of the risks of their impact on the environment. Sustainability should be the central theme in this context.

One of the appropriate tools for assessing the extent of environmental impacts is the mapping of changes in the structure of the country. Comparing the changes in land cover over the time makes it possible to express spatial and functional changes, as well as tendencies in the development of the country.

The main goal of this contribution is to report on the results of research aimed at analyzing changes in land cover and land use in the area of the paradyamic system at the contact of the Inner Eastern Carpathians and the East Slovak Lowland. Topographic maps and orthophoto maps from different time periods were used in the analysis. Digitization of map documents and subsequent topology control was performed using ArcGIS 9.1 software. The obtained information creates suitable space for further environmental analyses, such as assessment of landscape heterogeneity, ecological stability, or modeling natural processes in relation to land cover.

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Design of Methodical Procedures and Recommendations for the Evacuation of People from the Cableway of Skipark Erika

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Two pillars on which the owners of the Skipark Erika attempt to stem their business are environmentally friendly and safety operation.

This contribution deals with the design of methodical instructions for the evacuation of people from the cableway of Skipark Erika complex. We discuss active and reliable techniques and ways of the rescue of people from the cableways, as well as describe the used equipment, material and their application within the intervention.

The aim of the research is to design methodical instructions for the intervention of Fire and Rescue Service team during the evacuation of people from the cableway. Given methods and procedures as well as theoretical background relevant to the topic processing were consulted with and realized by experts in each of the areas of use concerned. The efficacy of the methods was verified by statistical evaluation of the tactical exercise results by Fire and Rescue Service team in Košice.

Modern Methods of Computer and Voice Control

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The use of voice-based access to control computers has become increasingly popular in recent years. This has led to the development of new technologies that allow users to interact with their devices in a more natural and intuitive way.

In this contribution, we propose exploring modern methods of computer and voice control. The aim of this research is to identify the most effective techniques for controlling computers using voice commands. The study focuses on the latest advancements in voice recognition technology, including natural language processing and machine learning algorithms. It also examines the use of gesture-based controls and other innovative methods for interacting with computers.

The results of this study could be useful for developers and designers who are working on new technologies for computer and voice control. Its conclusions can contribute to continuous growth and improvement in this research area.

Cluster Analysis for Verifying the Suitability of Indicators for Decision Tree Classification Method

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Cluster analysis is a method used to categorize similar objects into groups or “clusters” based on their similarity. This method is often used in the field of machine learning and data analysis. Decision tree classification method is a machine learning algorithm used for data classification.

In this contribution it is proposed to use cluster analysis to verify the suitability of indicators for decision tree classification method. The aim of this research is to determine whether certain indicators are suitable for decision tree classification method and what their border values are.

The results of this study could be useful for further research in the field of machine learning and data analysis. Machine learning has the potential to play a significant role in mitigating the impact of human activities on the environment. Economic sustainability in machine learning requires the fulfillment of one condition: systems should be designed to augment, rather than replace, human capabilities.

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On Sustainable Future of Steel

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In this contribution we report the highlights of 2022 Environmental, Social and Governance Report [1] as well as 2021 Sustainability Report [2] of the U. S. Steel Corporation.

According to U. S. Steel's 2022 Environmental, Social and Governance Report [1] steel is not only essential part of humans past, it's essential to a sustainable future. U.S. Steel Košice is a part of the U. S. Steel Corporation and the U. S. Steel Corporation is attempting to build sustainable future of steel. Environmental-friendly steel making process is the core priority at U.S. Steel and it is firmly embedded in the S.T.E.E.L. Principles that define practices and values of the Corporation. The future of Earth depends on safeguarding the vital natural resources. Hence, any solution of the steelmaking process must address the challenge that keeps our communities and ecosystems healthy.

Clearly, producing steel is carbon-intensive. As approximately 70–80% of the GHG emissions from integrated steelmaking are associated with the use of coke and coal to melt iron in blast furnaces, it is very important to set up energy-efficient production of steel in blast furnaces. Making steel by melting recycled steel scrap in EAFs helps to decrease greenhouse gas emissions. U. S. Steel recognizes the importance of having both routes of steel production and, therefore, it is focusing on process optimization, production efficiency and manufacturing environmentally friendly products while transitioning to a lower carbon economy. The continued commitment to improvement is reflected in its greenhouse gas emission target [3].

References

[1] U. S. Steel: 2022 Environmental, Social and Governance Report, Essential for Our Future, United States Steel Corporation, Pittsburgh, PA, USA, 1-99, 2023.

[2] U. S. Steel: 2021 Sustainability Report, United States Steel Corporation, Pittsburgh, PA, USA, 1-119, 2022.

[3] U. S. Steel: Climate Strategy Report, United States Steel Corporation, Pittsburgh, PA, USA, 1-30, 2023.

About Selected Innovative Environmentally Friendly Solutions on the Agricultural Market

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When you conduct business essential to life, every move makes an impact. Therefore, developing revolutionary technology and tools in order to cultivate greater financial outcomes, better workforce and sustainable environment is of high importance of engineers of John Deere.

This contribution is about strategic commitment of John Deere to sustainable practices that delivered several better outcomes for customers and communities. We will mention e.g. battery-electric backhoes that eliminate tailpipe emissions, a new and more intelligent sprayer that reduces herbicide use and other. These innovations help to protect the planet and save farmers money and time. For example the innovative See & Spray™ Ultimate revolutionary technology helped farmers reduce herbicide use by more than two-thirds in 2022 [1].

In order to deliver options to the small agriculture sector, John Deere aims to offer an electric option in each compact utility tractor product family by 2026 as well as deliver an autonomous, battery-powered electric utility tractor to the agro market by 2026. Hence, the modern trend of electromobility has affected this sector of production, as well.

Reference

[1] John Deere: Sustainability Report, Moline, ILL, USA, 1-43, 2023.

Sustainability of Technical Materials through Segmentation of Cracks in Materials

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Sustainability of technical materials is a very hot topic. Using materials in a way that does not harm the environment is currently a very popular subject. Sustainable materials management means using materials stably throughout their entire life cycles.

In this contribution we are talking about cracks in materials. We ask a question how long they last and try to find its answer. We also deal with the detection and possible prediction of cracks and aggregates in materials. We discuss the subject in 2D / 3D space.

Materials can be made up of small pieces called aggregates, a binder called cement, tiny holes for air, and fibers for added strength. Cracks are thin lines or substructures that form within the concrete. The way cracks feel might be different depending on the type of concrete. Finding defects in 2D or 3D pictures of materials is important for identifying patterns, pattern recognitions, image processing and mainly segmentations of cracks in materials. Applications are used in various ways, such as creating items like ceramic tiles or solar wafers for industries. Even recognition of cracks in objects like roads, wall of buildings, or cracks in steel, wood, and other materials is important.

In this study, we look at the ways how to find cracks by using mathematical segmentation methods. Specially, we focus on segmentation on cracks in different technical materials. Image processing and segmentation of image data plays an important role in these analyses.

The material we are dealing with is in concrete used for buildings and hence, it must be of a very good quality. Moreover, it has to be environmentally friendly and sustainable.

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Notes

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