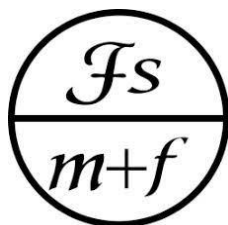


Towards Earth Resources: Innovations

Proceedings of workshop TER2022

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Preface

Dear participants of the workshop and other readers! You are currently opening the booklet of abstracts from the event entitled *Towards Earth Resources: Innovations* (TER2022). The aim of this workshop is to discuss current topics and issues related to innovations that can be connected with earth resources. The important is the presence of participants from the university and research environment as well as industry at this event. We believe that discussing the relevant topics in person has its added value.

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.

The workshop TER2022 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 TER2022 workshop and that it will lead to fruitful discussions and results.

Erika Fecková Škrabuľáková - Editor

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.	First 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. - 4:15 p.m.	4 th block of lectures
4:20 p.m. - 5:20 p.m.	Second problem section, brainstorming
5:20 p.m. - 5:30 p.m.	Closing of the event, summary, conclusions

1st block of lectures	
9:20 a.m. – 9:40 a.m.	<i>Stehlíková B. et al.</i> : Research on the Possibility of Identifying Some Failures during the Operation of the Belt Conveyor
9:45 a.m. – 10:05 a.m.	<i>Bednárová D. and Bogdanovská G.</i> : Quality Process Improving in Metallurgical Production
10:10 a.m. – 10:30 a.m.	<i>Ivanová M. et al.</i> : An Innovative View on Factors of the Quality of Life in Selected European Countries
Chairman:	<i>Erika Fecková Škrabuľáková</i>

2nd block of lectures	
10:50 a.m. – 11:10 a.m.	<i>Bogdanovská G. and Bednárová D.</i> : Assessment of the Quality of the Working Environment in the Treatment of Mineral Raw Materials
11:15 a.m. – 11:35 a.m.	<i>Šoltész Matulová J. et al.</i> : A New Way of View at the Steel Production Residuals
11:40 a.m. – 12:00 p.m.	<i>Stehlíková B. et al.</i> : Possibility of Classifying Objects on the Cave Wall Using 3D Records
Chairman:	<i>Mária Ždímalová</i>

First problem section	
Chairman:	<i>Matúš Fecko</i>

3rd block of lectures	
2:00 p.m. – 2:20 p.m.	<i>Drančák L.:</i> Practical Use of Deep Learning
2:25 p.m. – 2:45 p.m.	<i>Fecková Škrabuřáková E. and Fecko M.:</i> On Low-cost Changes that Lead to Cost Savings
2:50 p.m. – 3:10 p.m.	<i>Ždímalová M.:</i> Innovative Mathematical Techniques in Discrete Approach in Image Processing
Chairman:	<i>Dagmar Bednárová</i>

4th block of lectures	
3:30 p.m. – 3:50 p.m.	<i>Ždímalová M.:</i> Discrete Mathematical Algorithms for Image Processing and their Applications in Biology and Medicine
3:55 p.m. – 4:15 p.m.	<i>Martin Szabó:</i> On Fruits Considered as Natural Resources
Chairman:	<i>Beáta Stehlíková</i>

Second problem section	
Chairman:	<i>Gabriela Bogdanovská</i>

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Quality Process Improving in Metallurgical Production

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In line with the principles of sustainable development, the efficient recovery of raw materials from the recycling process and their reuse by returning them to the production cycle helps to conserve non-renewable raw material resources. There is an ongoing effort to continuously improve the technologies used, to increase their efficiency and to minimize their negative impact on the environment. It is important for a manufacturing organization to continuously monitor and manage its processes.

Some of the tools that make this possible are the statistical process control (SPC) tools. By applying these tools to manufacturing processes, an organization can assess the state of the process based on the regulated parameters and eliminate the effects of external influences through appropriate interventions. With a stable process, it is possible to ensure that the output of the process is as close as possible to the desired (target) value with minimal deviations.

In this contribution, research is presented on the pyrometallurgical processing of feed materials with different copper contents. The aim is to assess the possibility of active use of SPC tools in process monitoring and control in order to improve their quality and efficiency. Among the quality parameters monitored, the tin content in black copper, blister copper, converter ash and converter slag was selected. On the basis of the required parameters set, the aim of the process control is to ensure that the tin content is as high as possible in the converter ash.

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Assessment of the Quality of the Working Environment in the Treatment of Mineral Raw Materials

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Workplaces have work-related hazards that can affect people's health. These hazards are factors of the work environment - physical, chemical, biological, physiological, psychosocial, and others.

The latest statistical surveys show that noise is the most frequently occurring harmful factor in the occupational environment. Noise propagating into the environment during the production process is a significant issue related to the increase in noise emissions in both the living and working environment. Long-term exposure to noise reduces the quality of the work environment. It can have a negative impact on the health of workers, as well as the residents of adjacent towns and villages.

In this contribution we present a study aimed at reducing noise emissions arising from the treatment of mineral raw materials. Noise sources were identified and analyzed using the Cause and Effect diagram. Based on the measured values, measures were proposed and implemented in order to reduce the noise below the established permissible value of 50 dB.

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Practical Use of Deep Learning

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Deep learning is mostly considered as an important part of machine learning. Deep learning is defined as a type of machine learning in which computer analyzes algorithms and their results in order to "learn" ways to improve processes and create the new ones.

Deep learning technology is extremely helpful in creating statistical studies, creating models of the course of events, making predictions. The main advantage and utilization of using artificial intelligence, neural networks, machine learning and deep learning is the ability to automate many processes, perform analytical and physical tasks without human intervention, whether in the automotive industry or our chosen industry. Algorithms used in deep learning make it possible to create hierarchical models that are similar to human thought processes.

With the help of data collected in the manufacturing industry, we will try to integrate machine learning methods aimed at optimizing production and production processes as such. Through our data analysis, we will be able to identify where more precisely in the process it is possible to improve the process, and predict the error rate of devices. Defining scarcity leads to saving resources and time.

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On Low-cost Changes that Lead to Cost Savings

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Turbulent times of nowadays are characterized by rising inflation and growing prices of energies. This leads to the overall discussions about sparing energy and costs wherever it is possible. This topic is just as relevant on a national scale as it is in individual companies and households, as with a large number of small successes, some savings can also be recorded on a global scale.

The purpose of this contribution is to point out on small low-cost changes in households that can lead to remarkable energy and cost savings. Before all we focus on an effect of better insulation of specific areas of a household boiler, which can lead to remarkable financial and electricity savings. We provide a detailed comparison of the situation before and after the application of insulation for the same time period of two consequent years.

Our results show that some of the environmental attitudes and energy saving activities within households do not require a lot of initial expenses but bring good results.

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An Innovative View on Factors of the Quality of Life in Selected European Countries

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The aim of this contribution is to specify the factors that most significantly influence the quality of life of people in the European Union countries. The input database is created by 19 variables obtained from Eurostat database (April 10, 2021) pointing out to different parts of human life, such as factors of material living conditions, productive and other main activities, economical safety, health, education, social interactions, living environment and physical life satisfaction.

In order to achieve the aim of the contribution, we have used the method of principal components analysis (PCA). It led to the reduction of the dimensionality of the space and naming the important factors influencing the quality of life. Using the graph of components of weights and component scores, we were able to identify the interactions between factors and objects (EU countries).

Despite the fact that EU policy is long-term focused on renewable energy sources, reducing the carbon footprint and meeting the climate goals, our research confirmed that environmental factors do not play a primary role in the perception of quality of life. The subjective perception of happiness in some countries mainly increases with material values (Bulgaria, Greece, but also Romania and some other countries of the former Eastern bloc). Our results also indicate that if the level of economic development exceeds a certain value, the quality of life will continue to increase with non-material values (relationships, health, education).

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Possibility of Classifying Objects on the Cave Wall Using 3D Records

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Digital photogrammetry has brought a new way of thinking and working with maps. Currently, photogrammetry is used in various fields such as engineering design, natural resource and environmental inventory, hydrographic surveys and archaeological mapping.

This contribution deals with a partial solution of the task, the goal of which is to evaluate the change in the proportion of ice in a limited section of the wall of the Dobšinská ice cave, based on the records obtained by photogrammetric measurement.

The contribution is oriented to the processing of measurement results using statistical methods. The structure of data sets, i.e. records of measurements, selected values of statistical indicators, results of statistical evaluation and comparison of records of measurements from several periods will be considered. It will offer a view on solving the issue of the uniformity of the individual stages of measurements, considerations and procedures leading to the final classification, topics for further continuation of the classification task.

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Research on the Possibility of Identifying Some Failures during the Operation of the Belt Conveyor

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The belt conveyor is one of the most common tools of transporting bulk materials. It is widely used in industries such as mining, metallurgy, and others. It is an important continuous way of material transportation.

The aim of the belt conveyor system operation is to minimize physical work, which can fully utilize other energy. The goal of the research into operation of the conveyor belt system is to maximize the efficiency of this way of transportation. Obtaining the information about the behavior of the individual components of the belt conveyor on model devices brings useful information that can lead to a reduction in the failure rate as well as an increase in the efficiency of the device. Early identification of the belt conveyor malfunctions is an option to prevent further damage to equipment components and it saves costs for its operation.

This contribution deals with one way of identifying fault-free, proper operation of the belt conveyor and the identification of some faults of the belt conveyor.

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On Fruits Considered as Natural Resources

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In the current situation, when we are registering a rapid increase in the prices of energy, raw materials, fuel and other commodities, it is necessary to look for and find new material and energy sources. One possibility how to handle this problem is to use fruits or fruit residuals and processing them for fuel.

Commodities like stone fruit seed can be used as a source of biodiesel for transport. The oil extracted from the seed can be via alkaline catalysed transesterification process converted into biodiesel. The physicochemical properties of the produced biodiesel, as well as the engine performance, emissions and combustion behavior of engine fuelled with it match standard diesel and its performance in a four-cylinder diesel engine [1]. Agricultural products including apple, grape, orange, barley, wheat and similar generate green wastes upon processing in the food industry. These wastes can be processed into bioethanol for raising the octane number of gasoline. The advantage of this process can be seen in mitigation of climate change, tackle air pollution and in the cut of fossil fuel costs [2]. Other studies present the processing possibilities for marc resulted as residue from the distillation of fermented fruits in view to obtain a compacted solid fuel [3].

In this contribution we present the ways of current processing and waste disposal strategies of residues from local fruit processing facilities that have, beside other, also a fuel potential.

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A New Way of View at the Steel Production Residuals

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In this contribution we view dusts and sludges from steel converters as possible secondary raw materials. In order to evaluate the perspectives of their reuse we analyze their characteristic properties. These properties adjudicate about their valuable content and whether these by-products can be reprocessed instead of simply landfilled.

In our research we used standard research designs and methods such as titration, atomic absorption spectroscopy, inductively coupled plasma, optical emission spectrometry and combustion/fusion analysis.

By our study we have confirmed a large amount of precious metals and materials in our samples that can be recovered by suitable techniques. Instead of polluting the environment these secondary products of steelmaking process can be reused.

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Discrete Mathematical Algorithms for Image Processing and their Applications in Biology and Medicine

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In this contribution we present discrete and graph theory algorithms and their application into image processing. We focus on an algorithm, which is in literature known as a GrabCut algorithm. This type of algorithm is a multidisciplinary algorithm connecting graph cut methods, data clustering (k – means algorithm), mixture models and also image processing.

In our research we combine mathematical statistics, data clustering, Gaussian mixture models, and also image segmentation techniques. Consequently, we apply these techniques into the analyses of medical and biological image data. We provide a better segmentation on our data set. As a result we create new software according to the direct request of medical and biological data scientists. We apply this algorithm into diagnoses of brain tumors. We plan to extend its utilization into the breast and other types of tumors too.

As we see potential applications of our results in analyzing of technical materials and earth resources, these engineering related topics will be discussed in the contribution, as well.

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Innovative Mathematical Techniques in Discrete Approach in Image Processing

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In this contribution we present an innovative approach to image processing from discrete mathematics point of view. We present algorithms dealing with image analyses. Algorithms are based on discrete mathematics as well as graph theory. We deal with graph theoretical algorithms using max flow algorithms in the networks and Dijkstra's algorithm in Intelligent Scissors. Specially, we focus on Graph Cut algorithm and the Intelligent Scissors algorithm. We analyze biological data, cells, membranes of cells, radar data and others.

This work is a partial result of cooperation with Medical Faculty of the Comenius University in Bratislava. More concretely, we cooperate with the Institute of Immunology, the Institute of Anatomy, the Institute of Medical Physics, Biophysics, Informatics and Telemedicine. We have created, implemented, and also optimized new software on special requests of biological and medical data scientist. Some data were extracted also on microscopes used at the Medical Faculty of the Comenius University in Bratislava and achieved results were verified by both doctors and biologists.

Consequently, we propose other applications of our results in biology, medicine and geography. Our next aim is to exceed this work into analyses of technical materials and buildings.

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Notes

Notes

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