Computational Problems of Electrical Engineering 2023

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Book of Abstracts

Contents

Computational Intelligence in Engineering / 1

A Novel Approach using Vision Transformers (VIT) for Classification of Holes Drilled in Melamine Faced Chipboard

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This paper presents a comprehensive performance evaluation of various AI architectures for a classification of holes drilled in melamine faced chipboard, including custom Convolutional Neural Network (CNN-designed), five-fold CNN-designed, VGG19, single and five-fold VGG16, an ensemble of CNN-designed, VGG19, and 5xVGG16, and Vision Transformers (ViT). Each model's performance was measured and compared based on their classification accuracy, with the Vision Transformer models, particularly the B_32 model trained for 8000 epochs, demonstrating superior performance with an accuracy of 71.14%.

Despite this achievement, the study underscores the need to balance model performance with other considerations such as computational resources, model complexity, and training times. The results highlight the importance of careful model selection and fine-tuning, guided not only by performance metrics but also by the specific requirements and constraints of the task and context. The study provides a strong foundation for further exploration into other transformer-based models and encourages deeper investigations into model fine-tuning to harness the full potential of these AI architectures for image classification tasks.

Computational Intelligence in Engineering / 2

Impact of Signal Features on Machine Learning-Based Tool Condition Classification in the Milling Chipboard Process

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This study investigates the impact of various signal features on machine learning-based tool condition classification in the milling chipboard process. Different machine learning models such as XGBoost, Gradient Boosting, Decision Tree and Random Forest have been applied and the signal features have been ranked based on their importance. The highest ranking signal was 'DataLow_0', contributing over 16% of the total ranking. 'DataCurrent_2' and 'DataLow_1' were identified as the second and third most influential signals. On the contrary, 'DataCurrent_1' was found to be the least influential. It's essential to consider that the relative importance of these signals can vary depending on the specific tool condition and classifier used. Although signal importance rankings provide a relative understanding of these signals, further studies applying exploratory analysis and model interpretation techniques are recommended for an explicit understanding of the nature of the relationships between these signals and the target classification. In conclusion, understanding the influence of signal features is vital for effective design and optimization of machine learning models for tool condition classification in the milling chipboard process.

Poster Session / **3**

Methods of hiding information based on steganographic profiles

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The article describes the concept of steganography from the point of view of the issues of the physical and digital world. It discusses the basics of hiding information in data medium, indicates the potential in terms of their capacity and susceptibility to the phenomenon of data concealment. It also indicates aspects of the suitability of modified data for information retrieval and extraction. It uses the most popular algorithms to hide information and methods to determine the effectiveness of data hiding.

Poster Session / **4**

Procedural Generation of Virtual Cities

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In this article a comprehensive methodology for procedural generation of cities is introduced. The method consists of three distinctive stages for terrain, road network and building generation. Presented algorithm is flexible and customizable, providing user with possibility to adjust the generation process and final outcome to their specific needs. Two methods were implemented for each stage and later utilized to generate a collection of virtual cities, demonstrating the versatility of proposed approach.

Computational Models of Electrical Systems / **5**

Numerical Simulations of Static Magnetic Fields with Mu-metal Cage Shielding

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This article presents numerical simulations focused on static magnetic fields, employing a Mu-metal cage for shielding against the geomagnetic field. The objective is to verify, how a homogeneous and uniform magnetic field within the magnetic field applicator is created. Square Helmholtz coils are employed to ensure this homogeneity. Observations indicate a 5.3% deviation in the B-field when the coils are supplied with a DC current of 110 mA. In the absence of a DC field supply, a 12% deviation is observed. The impact of extremely low-frequency electromagnetic fields and static magnetic fields on living organisms is well-documented, emphasizing the significance of even small

changes and deviations in the magnetic field. This underscores the importance of employing a Mu-metal cage when investigating the effects of these fields. Numerical simulations using specialized software demonstrate that the highly permeable Mu-metal box provides approximately 90% shielding efficiency against the geomagnetic field.

Computational Intelligence in Engineering / 6

Dynamics of the Learning Process of a Multilayer Neural Network when using the AdaDelta Optimization Method

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Abstract. —The AdaDelta learning process optimization method has been tested for a multilayer neural network with three hidden layers with 28 neurons each, when recognizing printed numbers. Testing the learning error of this neural network was carried out using the mapping function and Fourier spectra of the error function. The mapping function describes the process of doubling the number of local minima. It is found that the application of the AdaDelta optimization method leads to a radically different picture of the behavior of the branching diagram than when applying the learning optimization methods Adam, AdamMax, and AMSGrad. Namely, with an increase in the number of iterations, the process is "extinguished" by retraining, by correcting the learning step of each neuron. It is shown that the hyperparameter ρ, which describes the contribution of the gradient square of the error function, significantly influences on the learning process of the neural network. That is, increasing the optimization parameter ρ to (0.9÷0.999) causes a decrease in the region of change of the magnitude of the learning step. The step is selected automatically during training, for each neuron according to the AdaDelta optimization algorithm. It is shown that the optimal value of the optimization parameter ρ is 0.9 .

Industrial Applications / 7

Extruder Design for 3D Printing of Ceramic Materials

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This paper deals with the design and development of an extruder for printing ceramic materials including its control. The paper describes the experimental development of the extruder, divided into a mechanically extruded stack and the method of feeding the material into a print head equipped with a screw conveyor. The paper includes a computer model of the designed extruder. The aim of the paper is to demonstrate the proposed extruder and verify its functionality.

Computational Intelligence in Engineering / 8

Application of Mask R-CNN Algorithm for Apple Detection and Semantic Segmentation

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This research presents an application of the Mask R-CNN algorithm for apple detection and semantic segmentation, aiming to enhance automation in the agricultural sector. Despite the growing use of deep learning techniques in object detection tasks, their application in agricultural contexts, specifically for fruit detection and semantic segmentation, remains relatively unexplored. This study evaluates the performance of the Mask R-CNN algorithm through a series of numerical experiments, with metrics including mean intersection over union (mIoU), F1 score, accuracy, and a confusion matrix analysis. Our results demonstrated that the Mask R-CNN model was effective in detecting and segmenting apples with a high degree of precision, achieving an mIoU of 0.551, an F1 score of 0.704, and an accuracy of 0.957. However, areas for potential improvement were also identified, such as reducing the model's false negative rate. This study provides insights into the application of deep learning algorithms in the agricultural sector, paving the way for more efficient and automated fruit harvesting systems.

Computational Intelligence in Engineering / 9

Teaching Maxwell Equations with LLM Assistance

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Large Language Models (LLMs) have been gaining tremendous popularity since early 2023 with the release of the GPT-4 system. The new artificial intelligence methods have successes in many fields of activity, including education. This article analyses the applicability of LLMs in supporting the teaching of the "Electromagnetic Fields" course in Electrical Engineering studies. Examples of use in various teaching activities are presented. Particular emphasis was placed on demonstrations of mechanisms for introducing detailed knowledge into the model. Advantages, but also risks associated with the use of the proposed methods were discussed.

Poster Session / 10

Short-circuit current evaluation with the aid of static compensators

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The article presents analysis of static compensator influence on average power flow. It is shown that the compensator current affects on the power delivered to the consumers. The real time iterative method of compensator control in was presented. The RMS value of grid voltage is chosen as the target of the compensator. The results prove the effectiveness of the proposed control method.

Computational Models of Electrical Systems / 11

Improved model of rapid cooling in the process of laser or small-scale induction hardening

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The paper presents and discusses an enhanced version of modeling laser or small-scale induction hardening. The process is characterized by a rapid cooling rate, reaching several hundred or over one thousand degrees Celsius per second. Most heat from the heated spot is transferred through conduction rather than convection, penetrating deep into the material's interior. Consequently, determining the surface hardness based on the continuous cooling transform (CCT) diagram is challenging. Typically, the cooling curves in the CCT diagram are only available for rates of around tens of degrees Celsius per second. To address this issue, the paper introduces a model that utilizes optimization procedures supplemented by calibration through specific measurements to estimate the resulting hardness. The methodology is demonstrated through an illustrative example, and the obtained results are compared.

Poster Session / 12

Capacitive measurement of infusion fluid volume

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The article presents a system for monitoring fluid during intravenous infusion. The system is based on a capacitive method in which the change in electrical capacitance of the infusion container is converted into the current volume of the fluid. The capacitor pads of the measurement system are integrated into the housing of the container, facilitating easy installation in hospital conditions without significantly altering the dimensions of the infusion set. The system has been tested with target infusion fluids, and the volume measurement error within the entire measurement range is less than 6%. The current fluid volume is displayed on an LED strip to quickly inform the personnel, and the system also has the capability to provide an alarm for low fluid levels.

Computational Intelligence in Engineering / 13

Comparative Analysis of Independent Component Analysis, Linear Regression and Adaptive Filtering for Artifact Removal in SSVEP Registration

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Artifacts pose a significant challenge in the analysis of EEG signals. Physiological artifacts stem from natural activities of the human body, such as swallowing saliva, clenching the jaw, facial grimacing, and eye blinking, among others. Visual evaluation often serves as the basis for artifact elimination. In this study, the authors investigated the impact of artifacts on the detection of steady-state visually evoked potentials (SSVEPs). The article explored various techniques for artifact elimination, including linear regression, adaptive filters, and independent component analysis (ICA). The effectiveness of the algorithms was evaluated using classification accuracy as a metric. The results indicate that the most promising outcomes were achieved with independent component analysis. However, this method requires expert knowledge and may not always be feasible. On average, a 30% increase in the classification accuracy of evoked potentials was observed in signals cleaned using ICA. The linear regression method and the recursive least squares (RLS) adaptive filtering showed either improvement or no deterioration. Among the examined EEG signal-cleaning methods, the normalized least-mean-square (NLMS) filter exhibited the poorest performance.

Computational Intelligence in Engineering / 14

Implementation of Convolutional Neural Network for Artifact Removal from EEG Signals

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Artifacts that occur during the registration of electroencephalographic signals (EEG) pose a significant problem, hindering the analysis of these signals for medical diagnosis or brain-computer interfaces (BCIs). While some artifacts can be relatively easily removed, others, such as those related to muscle activity, are more challenging to eliminate. Continuous research is being conducted to discover methods for removing physiological artifacts resulting from the natural activity of the individuals. In this article, the authors propose a method for removing electromyographic (EMG) artifacts from EEG signals using convolutional neural networks (CNNs). To accomplish this, a method for augmenting EMG and EEG signals is proposed. The authors performed artifact removal tests using a trained CNN for both real and simulated signals. The obtained results indicate that the proposed method shows promising outcomes and enables effective removal of demanding artifacts, such as jaw clenching.

Industrial Applications / 15

An improved model of hardening gear wheels and determining the electrical efficiency of the process

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The paper presents an improved model of induction hardening of gear wheels. Although the mathematical model of the hardening is well known, some parameters are subject to uncertainties (temperature dependence of material parameters, coefficient of convective heat transfer, or emissivity). The authors offer a methodology based on calibration and optimization techniques to minimize the relevant errors and illustrate it with a typical example.

Poster Session / 16

Analysis of Event-Related Potentials for Emotion Recognition

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The primary objective of this study was to determine the feasibility of classifying emotions into three categories (positive, negative, and neutral) using event-related potentials (ERPs) for individual users. Visual stimuli from the International Affective Picture System (IAPS) database were utilized. Various features, such as signal samples, discrete wavelet transform, discrete Fourier transform, and discrete cosine transform, were computed from one-second electroencephalographic signal (EEG) segments following the presentation of the stimulus. For the classification task, a one-nearest neighbor classifier (1-NN) was employed. The research yielded a system for preprocessing and classifying emotions. The study involved eight participants. The experiments presented in this paper demonstrate the possibility of distinguishing emotions into three categories (pleasant, unpleasant, and neutral) for a single user, achieving an average accuracy level of 87%. However, when considering all users collectively, we achieved a classification accuracy of 96%.

Computational Models of Electrical Systems / 17

On the Adequacy of Analysis of Linear Periodically Time-Variable Circuits by the Frequency Symbolic Method Using Matrix D-Trees

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Abstract—the frequency symbolic method (FS method) of steady-state analysis of linear periodically time-variable (LPTV) circuits is used to form their transfer functions in the frequency domain. A Fourier polynomial approximates the transfer function and contains the complex variable, the time variable, and the parameters of the circle elements in the form of symbols. The coefficients of such Fourier polynomials using the FS method are unknown in the symbolic systems of linear algebraic equations (SSLAE) and are defined as their solutions in symbolic form. A well-known drawback of solving such SSLAEs is the significant increase in the required computer time when the number of unknowns increases. This shortcoming has been corrected by using one of the methods of subcircuits namely, the topological method of d-trees.
The matrix d-trees method, provides close to optimal rendering of similar in-formed expressions. This is the reason for the significant reduction in the time of their formation, the reduction of the required amount of memory and the high speed of the symbolic matrix d-trees method in general. It leads to a significant expansion of circles admissible for analysis according to their complexity.
The FS method, which uses the matrix d-trees method, has been implemented in the system of user-defined functions MAOPCs. The article presents the results of computer experiments that show the adequacy of the system.
Four programs have been used to compare the calculation results: Micro-Cap 12.2.0.4, NI Multisim

14.24, and Simulink 10.6(R2022b). The system of user-defined functions MAOPCs showed the highest speed when modelling complex parametric circles containing hundreds and thousands of parametric elements (this is not a typo).
Keywords—linear periodically time-variable circuit, the system UDF MAOPCs, the matrix d-Trees method

Poster Session / 18

Facial recognition system based on the Haar cascade classifier method

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This scientific research is devoted to the analysis and testing of the Haar cascade classifier method for face recognition. The paper also justifies the choice of algorithm and provides a description of the implementation of the system on which the analysis was conducted. During the research, the developed system was tested on a sample of facial photographs that included images at different distances from the camera, different lighting conditions, and with different facial positions in the camera's plane of view. An analysis of the test results was conducted, and conclusions were drawn regarding the factors that should be considered when designing and using a facial recognition system to achieve high accuracy.

Computational Intelligence in Engineering / 19

Specialized game computer system based on Arduino Uno

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Specialized game computer system based on Arduino Uno - indie project was proposed and investigated. Based on the analysis of the current state of the gaming industry and global trends, the main theses of a successful product, its implementation, operation and the main stages of development were formed. The solution of key problems at all stages of development was described, the corresponding testing of both separate components, and all system as a whole were carried out.

Poster Session / 20

Study of the dynamics of arc length regulation of an arc furnace based on the fuzzy impedance-admittance law

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An electromechanical system (EMS) for adjusting the arc lengths of an arc furnace (AF) using a fuzzy model for the electrodes movement control is proposed. A fuzzy impedance-admittance law to form the electrical mode (EM) mismatch signal is created and the use of a fuzzy corrector for the electrode motion control signal is validated. A parametric synthesis of the fuzzy corrector based on the Tkagi-Sugeno model and a structural scheme were developed to implement the fuzzy impedance-admittance law of EM mismatch signal formation. A Simulink model of the developed EMS for fuzzy control of AF arc lengths was created. Simulation and comparing the control performance of deterministic and random disturbances using the proposed EMS structure and a typical arc power controller of the DSP-200 arc furnace were carried out. The analysis showed an improvement in the dynamics and energy efficiency using EMS with the developed fuzzy system engineering solutions in comparing with the performance of a serial arc power controller of the ARDM-T-12 type for the DSP-200 arc furnace.

Poster Session / 21

Modelling and simulation of radiofrequency electromagnetic field interaction with male uro-genital system

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This paper discusses the simulation of radiofrequency electromagnetic field thermal effects on the male urogenital system. It aims to simulate the radiation of a mobile phone, which can be placed in the pocket of the person using the device. A voxel model was used, which was modified only for the lumbar region. Several simulations were created with different antenna power values. Even with the increased power of the antenna, it is clear from the results that the SAR value did not exceed its limit levels.

Computational Intelligence in Engineering / 22

Relabeling the imperfect labeled data to improve recognition of face images using CNN

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The paper considers the problem of improving
the recognition of not-perfect labeled face images using CNN networks. The proposed solution is based on relabeling the samples of images by applying the KNN classification principle based on the distance between the samples. The original images are first converted to the features and the KNN principle is applied to them. The classes of sample images are relabeled according to the class represented by most neighbors indicated by KNN. The developed system was tested on the problem of face recognition. The dataset was composed of 68 classes of grayscale images. The results of experiments have shown significant improvement in the recognition rate of not perfectly labeled images

Industrial Applications / **23**

Verification of the effect of hot springs on arteriosclerosis based on the mathematical model of arteriosclerosis onset II: in case of weak radioactive springs

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In order to narrow down the characteristics of hot springs that have efficacies on arteriosclerosis, changes in skin cholesterol levels after bathing at the Yobizuru Onsen, which is classified as a simple weakly radioactive cold mineral spring, were measured. As a result, based on the results from the mathematical model of arteriosclerosis onset, it was indirectly shown that the nature of a radioactive spring may not have an efficacy on arteriosclerosis. In the future, in order to clarify which of the two characteristics (alkaline, sulfur spring) has the efficacy on arteriosclerosis, it is necessary to investigate hot springs that have only one characteristic, alkaline or sulfur spring.

Poster Session / **24**

Basic model for verification of the simulation methodology of the analysis of EFT/Burst transient disturbances

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The research aimed to verify the adopted methodology for testing transients in circuits with inductive elements during their disconnection. The main focus of interest is the electromagnetic disturbances named electrical fast transients (EFT/Burst) that occur on this occasion. The analytical derivation allowed us to know the nature of the transition state and various cases that depend on the parameters of the circuit. Simulations are becoming more and more common due to their high accessibility. On the other hand, progress in this area allows for an increasingly faithful representation of reality. A comparison of the results obtained from the simulation allowed us to verify their correctness. Measurements on a physical bench were the reference point for both methods. The results obtained from all three ways allowed us to confirm the adopted research methodology.

Poster Session / **25**

Evaluation of Artificial Notches in Conductive Biomaterials by Sweep Frequency Eddy Current Testing

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Electromagnetic nondestructive evaluation of conductive biomaterials using the sweep frequency eddy current method is the subject of this work. The main aim is to verify its use in the investigation of artificial defects that are located inside the austenitic stainless steel. For this purpose, numerical simulations and experiments were carried out, the results of which will be compared and evaluated.

Poster Session / **26**

Application of wavelet transform in analysis of cough sound records

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The work deals with the analysis of a digital recording of cough sounds. This signal was obtained using a digital recorder with a microphone placed on the patient's chest. The wavelet transform was used in this work. The principle of its operation, various wavelet functions, and types of these functions are described. The core of the work is the continuous wavelet transform algorithm. The source code for the continuous wavelet transform applied to selected parts of the cough sound recording was created and tested in MATLAB.

Computational Intelligence in Engineering / **27**

Smart indoor air quality monitoring system: implementation and analysis

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This paper presents the design and development of an intelligent air quality monitoring system that utilizes the widely adopted and versatile Arduino Uno microcontroller as its foundational platform. The system underwent comprehensive testing procedures to ensure its adherence to specified requirements. Moreover, a series of experiments were conducted in diverse areas of a residential environment to generate datasets for various air quality indicators. The research findings showcase the potential of the developed system in accurately monitoring and assessing indoor air quality in real-time. Enhancing indoor air quality plays a crucial role in mitigating the transmission of common airborne viruses and pollutants, thus significantly benefiting respiratory health.

Industrial Applications / **28**

Some issues and implementation problems for digital substations in Mongolia

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Digital substations, based on technologies like IEC 61850 and IEC 60870, are at the forefront of modern power grid advancements, offering enhanced automation, communication, and control capabilities. Mongolia's Ministry of Energy initiated efforts to transition to digital substations as part of their "Smart Energy" project. However, implementing these advanced systems in Mongolia is not without challenges. This paper explores key implementation problems encountered during the transition to a digital substation in Mongolia, with a focus on IEC 61850 and IEC 60870 protocols, time synchronization, fiber optic devices, intelligent devices, telemechanics, SCADA, and Wide-Area Monitoring Systems (WAMS). The paper aims to identify these challenges and offer potential solutions to ensure the successful deployment and operation of digital substations in Mongolia.

Industrial Applications / 29

Development of a UAV-based System for Technical Diagnostics of Overhead Power Lines

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Abstract—The problems associated with the operation of overhead power lines and ways of improving control over their condition with the help of UAVs are considered. A structural diagram of the system of technical diagnostics of overhead lines based on UAVs was developed, for which the necessary diagnostic parameters were selected according to informative criteria. An analysis of types of UAVs was carried out in order to determine their suitability and efficiency of use for diagnosing the condition of overhead lines.
Keywords—overhead power line, technical diagnostics, UAV, non-destructive testing

Computational Models of Electrical Systems / 30

Application of the Rastrygin's Method in Modeling of Complex Electrical Systems

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The paper considers the stochastic optimization method, which can be used for dynamic processes modeling in complex electrical systems, which are described by input- output models. As the main method, Rastrygin's guide cone method is considered. Limitations for this method are formulated for the practical usage when solving applied optimization problems. In order to improve the method,

modifications of its algorithm are proposed. The effectiveness of these algorithms is verified on test objective functions. The results of numerical experiments made it possible to conduct a comparative analysis of these algorithms.

Poster Session / **31**

Recognizing User Emotion Based on Keystroke Dynamics

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The paper presents a study concerning recognizing user emotion based on keystroke dynamics of the written text. At first, the analysis of the dataset used in the task is performed. Followed by the training and the effectiveness assessment of classical methods: Naive Bayes, K-Nearest Neighbours, Random Forest, and Multilayer Perceptron applied to the classification of provided samples to one of four emotions: anger, calm, happiness, sadness. The precision, recall, F1 score and time performance are evaluated. The Random Forest and MLP classifiers performed best, with an overall F1 measure of 84.83% and 80.47%, respectively. The scenarios for extending the training data set are presented in the second part of the paper, and the classification results of newly gathered data are analyzed.

Computational Intelligence in Engineering / **32**

Monocular depth estimations for UAV and high voltage power lines inspection

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High voltage power lines inspection requires high amount of effort and time and needs to be performed regularly. As high voltage power lines are critical infrastructure reducing the frequency of the inspections is not an option. To reduce effort required, some tasks can be automated. For example assessment of the state of transmission towers and power lines or autonomous UAV flights to gather necessary data for assessment. One of the core requirements for autonomous navigation is perception of the surroundings in the form of depth estimation. For UAV the most straightforward way is to use camera already mounted on the vehicle. Existing models for monocular depth estimation mostly focus on ground vehicles, such as cars, or generic UAV navigation. In this paper some models for monocular depth estimation were evaluated in the context of high voltage power lines inspection and navigation around such structures.

Poster Session / **33**

Fast electromagnetic field solver for transient antenna simulations

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This paper introduces a Finite-Difference Time Do- main (FDTD) electromagnetic field solver focused on speed and low-memory usage. It solves both electric and magnetic fields on axisymmetric grids. The accuracy of the code has been compared to the equivalent Finite Element Method (FEM) models in 2D and 3D. Finally, the performance metric of the FDTD solver has been estimated and compared with a FEM code.

Poster Session / **34**

Discovering Rules with Convolutional Neural Networks

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This paper uses convolutional neural networks to try to discover the rules of a few exemplary processes.
As the test cases, we consider John Conway's Game of Life and plane wave propagation in a vacuum.
Both processes can be represented as a convolution of a 3-by-3 mask with an image.
In the case of Game of Life, the image is a binary image representing dead/alive cells.
For the wave propagation example, the image is a grayscale image. The brightness represents the intensity of an electric field in a perpendicular direction to the plane of the image.
It seems that both of the processes can be rediscovered using a simple convolutional neural network.

Industrial Applications / **35**

The concept of a cheap universal capacitive partial discharge sensor

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This following article presents the concept of a cheap universal capacitive sensor for partial discharge (PD) measurement. The authors checked the effectiveness of the device prototype on a MV air-insulated switchgear. For this purpose, a combination of a widely used Transient Earth Voltage (TEV) sensor and a detector with Junction Field-Effect Transistor (JFET) was used. The paper presents the results of PD measure- ments with TEV sensors depending on the phase of the supply voltage. The conducted experiment is the basis for developing the functionality of the sensor and further research.

Industrial Applications / **36**

Intelligent Analyzing Module in the Academic Staff Performance Appraisal System

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In the scientific work, a module is proposed that allows to detect incorrect and irrelevant information based on the content analysis of web resources in the intellectualized academic staff performance appraisal system. The methods and means of detecting irrelevant information based on existing user needs are analyzed. This module allows to analyze the information filled in by the user and make an automatic analysis of its correctness.

Computational Models of Electrical Systems / 37

The Specific Absorption Rate of 10g and 1g methods comparison for a child and an adult in a shielded space of railway compartment

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This study compares two SAR techniques (10g method and 1g method) on a chest model of an adult and a child in the shielded area of a train car compartment to examine the impact of electromagnetic (EM) fields. This study made use of electromagnetic modeling based on the Finite Integration method. The simulations were done for a particular scenario in which each model was positioned as near to the EM radiation source as possible in a shaded area. The radio frequency source for the EM field was a PIFA antenna operating at 900 and 1800 MHz. By simulating the absorption of EM radiation on the chests of an adult and a child, the results were evaluated in terms of SAR values. The results showed that the SAR values for the child chest model were greater than for the adult chest model.

Computational Models of Electrical Systems / 38

Magnetic circuit of the electromagnetic flow meter

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Measuring the flow of carbonated drinks is not completely resolved. Carbonated drinks are liquids of an inho- mogeneous type. Individual drinks differ in many parameters (e.g. conductivity, pH, color, etc.) and any change in temperature or pressure affects these parameters. The article describes the design and optimization of the magnetic circuit of an induction flow meter for measuring carbonated beverages.

Computational Models of Electrical Systems / 39

Correction factor in current pulse measurements

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The article presents an analysis of the possibility of taking into account the correction factor for the measured values of the current pulse. For this purpose, the article presents the results of tests using various types of Pearson coils. The features of such a correction factor, method, and scope of application are defined. The obtained results are the basis for further research in order to determine the scope of application of the correction factor.

Poster Session / 40

Collision chemistry impact on Townsend's avalanche development

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This scientific article explores the impact of collision chemistry on Townsend's avalanche development through an innovative computational approach. By combining the Particle- in-Cell (PIC) algorithm and Monte Carlo (MCC) collisions, we determine the first Townsend coefficient for Helium gas. Further, we investigate the influence of a variable number of collisions in our simulations to achieve accurate compliance with experimental results. A distinctive aspect of this work involves the use of a custom-built meta-programming library in the Julia programming language, enabling automatic code generation for enhanced efficiency and reproducibility.

Industrial Applications / 41

Building model of processing and identifying engine vibration signal

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he advancement of the sensor technology becoming increasingly cost-effective and the progress in diagnostic and management research, users nowadays not only demand high reliability from their devices but also the ability for their equipment to self-diagnose errors and provide alerts. These devices often incorporate sensor systems capable of generating tens of thousands of data points per minute, that needed a carefully targeted algorithms for extracting features from the data for classification and prediction models. In this paper, we will develop a comprehensive model for identifying vibration signals. We will extract features from the bearing data provided by Case Western Reserve University (CWRU) Bearing Data Center [1], then use a deep-learning based convolutional neural network to learn to be a classification model of the motor states based on the vibration signals. The numerical results show that the method can offer the promising accuracy at 85.8%.

Poster Session / 42

Prediction of athletes'performance results using machine learning algorithms

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In the paper, we present the machine learning algorithm to predict 100m men's outdoor sprint score. For this project, a unique dataset of 17 features was created. The training set contained 174,383 records, whereas the test set contained remaining 406,894 records (proportions: 30% of training data to 70% of test data). The proposed multi-layer MLP model is based on set of features, such as weather conditions, locations of competition and athlete's personal information. The achieved method performance was 78% in term of accuracy, with 0.13s tolerance.

Opening / 43

Application of the Modern Optimization Techniques to Modeling of Complex Electrical Systems

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Industrial Applications / 44

A special chamber for testing electromagnetic emissions in the near field zone

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This article describes the construction of a test stand for locating disturbance sources using an EMC scanner placed in a dedicated EMC test chamber. In the description of the construction of the stand, special attention was paid to the EMC test chamber and the solutions used for shielding and minimizing reflections of electromagnetic waves inside the chamber. The research results presented in this article concern the influence of the chamber shield on the possibility of locating the source of disturbances. Mainly, the results obtained when only shielding materials were used in the chamber to eliminate background disturbances of the environment and when ferrite plates were additionally installed on the walls were compared. The obtained test results in the chamber with ferrite plates on the walls are satisfactory.

Poster Session / 45

Using computer simulations to identify the source of electromagnetic disturbances occurring in the high-current laboratory

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This paper presents the application of ANSYS circuit simulator for the identification and evaluation of the potential sources of electromagnetic disturbances in the high- current laboratory environment. Use of the computer model of the test circuit and comparison of the simulation results with the measurements allowed to confirm the hypothesis that the characteristic patterns of transient signals are caused by the non- simultaneous closing of the switch contacts.

Poster Session / 46

Scale system for on-line measurement and detection of the low level intravenous infusion fluid–development study

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The article presents the proprietary development version of the system for monitoring and detecting a low level of infusion fluid, initiated by a medical university. The results presented earlier by one of the coauthor are the basis for expanding the functionality of the measurement device. Additional features include the handling of multiple containers with liquid by a single station (just as for a classic IV stand), the use of standard protocols for communication between the station and the desk of the duty person. Regardless of the previous works, a different microcontroller was used, this time from the Cortex family. Additional functions of the measurement station increase its capabilities and increase the integration potential to create a distributed supervision and monitoring system, as in the case of SCADA, DCS or recipe systems.