*eng*

MDPI

*Editorial*

# Special Issue: Feature Papers in *Eng* 2022

**Antonio Gil Bravo**

INAMAT2, Science Department, Public University of Navarra, Campus of Arrosadia, Building Los Acebos, E-31006 Pamplona, Spain; andoni@unavarra.es

The aim of this second *Eng* Special Issue is to collect experimental and theoretical re-search relating to engineering science and technology. The general topics published in *Eng* are as follows: electrical, electronic and information engineering; chemical and materials engineering; energy engineering; mechanical and automotive engineering; industrial and manufacturing engineering; civil and structural engineering; aerospace engineering; biomedical engineering; geotechnical engineering and engineering geology; and ocean and environmental engineering. This editorial is an overview of the selected representative studies on these topics.

This book contains 33 papers, including 2 *Review* papers and 1 *Communication*, published by several authors interested in new cutting-edge developments in the field of engineering. Recently, a subcategory of nanotechnology—nano- and microcontainers—has developed rapidly, with unexpected results. Nano- and microcontainers refer to hollow spherical structures in which the shells can be organic or inorganic. These containers can be filled with substances released when excited and can be used in corrosion healing, cancer therapy, cement healing, antifouling, etc. In the first review, the author summarizes the various innovative technologies that have beneficial effects on improving people's lives [1].

Jombo and Zhang [2] report that traditional means of monitoring the health of industrial systems involve the use of vibration and performance monitoring techniques, among others. In these approaches, contact-type sensors, such as accelerometers, proximity probes, pressure transducers and temperature transducers, are installed on the machine to monitor its operational health parameters. However, these methods fall short when additional sensors cannot be installed on the machine due to cost, space constraint or sensor reliability concerns. On the other hand, the use of an acoustic-based monitoring technique provides an improved alternative, as acoustic sensors (e.g., microphones) can be implemented quickly and cheaply in various scenarios and do not require physical contact with the machine. The collected acoustic signals contain relevant operating health information about the machine, yet they can be sensitive to background noise and changes in machine operating condition. These challenges are being addressed from the industrial applicability perspective for acoustic-based machine condition monitoring.

Solar generation has increased rapidly worldwide in recent years, and it is projected to continue to grow exponentially. A problem exists in that the increase in solar energy generation will increase the probability of grid disturbances. The study presented by Soto et al. [3] focuses on analyzing the grid disturbances caused by the massive integration into the transmission line of utility-scale solar energy loaded onto the balancing authority high-voltage transmission lines in four regions of the United States electrical system: (1) California, (2) Southwest, (3) New England, and (4) New York. A statistical analysis of the equality of means was carried out to detect changes in the energy balance and peak power. The results show that, when comparing the difference between hourly net generation and demand, energy imbalance occurs in the regions with the highest solar generation: California and Southwest. No significant difference was found in any of the four regions in relation to the energy peaks. The results imply that regions with greater utility-level solar energy adoption must conduct greater energy exchanges with other



**Citation:** Gil Bravo, A. Special Issue: Feature Papers in *Eng* 2022. *Eng* **2023**, *4*, 1156–1166. https://doi.org/10.3390/eng4020067

Received: 11 April 2023
Accepted: 12 April 2023
Published: 14 April 2023

regions to reduce potential disturbances to the grid. It is essential to bear in mind that, as the installed solar generation capacity increases, the potential energy imbalances created in the grid increase.

The Jiles–Atherton model is commonly used in the hysteresis description of ferromagnetic, ferroelectric, magneto strictive and piezoelectric materials. However, the determination of model parameters is not straightforward because the model involves numerical integration and the solving of ordinary differential equations, both of which are error-prone. As a result, stochastic optimization techniques have been used to explore the vast ranges of these parameters in an effort to identify the parameter values that minimize the error differential between experimental and modelled hysteresis curves. Because of the time-consuming nature of these optimization techniques, Khemani et al. [4] explored the design space of the parameters using a space-filling design. This design provides a narrower range of parameters to look at with optimization algorithms, thereby reducing the time required to identify the optimal Jiles–Atherton model parameters. The authors also indicate that this procedure can be carried out without using expensive hysteresis measurement devices, provided that the desired transformer's secondary voltage is known.

Nuclear energy is currently in the spotlight as a future energy source all over the world amidst the global warming crisis. In the current state of miniaturization, through the development of advanced reactors, such as small modular reactors (SMRs) and micro-reactors, a fission battery was created, inspired by the idea that nuclear energy can be used by ordinary people using the "plug-and-play" concept, such as chemical batteries. As for the design requirements, fission batteries must be economical, standardized, installed, unattended and reliable. Furthermore, the commercialization of reactors is regulated by national bodies, such as the United States (U.S.) Nuclear Regulatory Commission (NRC). At the international level, the International Atomic Energy Agency (IAEA) oversees the safe and peaceful use of nuclear power. However, regulations currently face a significant gap in terms of their applicability to advanced non-light water reactors (non-LWRs). Therefore, Lee and Diaconeasa [5] investigated the regulatory gaps in the licensing of fission batteries concerning safety in terms of siting, autonomous operation and transportation and suggested response strategies to supplement them. To determine the applicability of the current licensing framework to fission batteries, the authors reviewed the U.S. NRC Title 10, Code of Federal Regulations (CFR) and IAEA INSAG-12. To address siting issues, the authors also explored the non-power reactor (NPR) approach for site restrictions and the permit-by-rule (PBR) approach for excessive time burdens. In addition, they discussed how the development of an advanced human–system interface augmented with artificial intelligence and monitored by personnel for fission batteries may enable successful exemptions from the current regulatory operation staffing requirements. Finally, they also indicated that no transportation regulatory challenge exists.

Sharafeldin et al. [6] present in an interesting study that intersections are commonly recognized as crash hot spots on roadway networks. Therefore, intersection safety is a major concern for transportation professionals. Identifying and quantifying the impact of crash-contributing factors are crucial to planning and implementing the appropriate countermeasures. This study covered an analysis of nine years of intersection crash records in the State of Wyoming to identify the contributing factors to crash injury severity at intersections. The study involved an investigation of the influence of roadway (intersection) and environmental characteristics on crash injury severity. The results demonstrated that several parameters related to intersection attributes (pavement friction, urban location, roadway functional classification, guardrails and right shoulder width) and two environmental conditions (road surface condition and lighting) influence the injury severity of intersection crashes. This study also identified the significant roadway characteristics influencing crash severity and explored the key role of pavement friction, which is a commonly omitted variable.

In Ref. [7], Andersen et al. present the use of a high-fidelity neural network surrogate model within a Modular Optimization Framework for the treatment of crud deposition as a

constraint while optimizing the light-water reactor core loading pattern. A neural network was utilized for the treatment of crud constraints within the context of an advanced genetic algorithm applied to the core design problem. This proof-of-concept study shows that loading pattern optimization aided by a neural network surrogate model can optimize the manner in which crud distributes within a nuclear reactor without impacting operational parameters such as enrichment or cycle length. Several analysis methods were investigated by the authors. The analysis showed that the surrogate model and genetic algorithm successfully minimized the deviation from a uniform crud distribution against a population of solutions from a reference optimization in which the crud distribution was not optimized. Strong evidence shows that boron deposition in crud can be optimized through the loading pattern. This proof-of-concept study shows that the employed methods provide a powerful tool for mitigating the effects of crud deposition in nuclear reactors.

For the first time, Zayed et al. [8] study the Fokas–Lenells equation in polarization-preserving fibers with multiplicative white noise in the Itô sense. Four integration algorithms were applied by the authors, namely, the method of modified simple equation (MMSE), the method of sine-cosine (MSC), the method of Jacobi elliptic equation (MJEE) and ansatze involving hyperbolic functions.

The next study evaluated unsupervised anomaly detection methods in multispectral images obtained with a wavelength-independent synthetic aperture sensing technique called Airborne Optical Sectioning (AOS) [9]. With a focus on search-and-rescue missions that apply drones to locate missing or injured persons in a dense forest and require real-time operation, the authors evaluated the runtime vs. quality of these methods. Furthermore, they also showed that color anomaly detection methods that normally operate in the visual range always benefit from an additional far infrared (thermal) channel.

Tebuthiuron is a selective herbicide for woody species and is commonly manufactured and sold as a granular formulation. In an interesting study, the authors of [10] investigated the use of infrared spectroscopy for a quality analysis of tebuthiuron granules, specifically the prediction of moisture content and tebuthiuron content. A comparison of different methods showed that near-infrared spectroscopy showed better results than mid-infrared spectroscopy, while a handheld NIR instrument (MicroNIR) showed slightly improved results over a benchtop NIR instrument (Antaris II FT-NIR Analyzer). The best-performing models gave an R2CV of 0.92 and an RMSECV of 0.83% $w/w$ for moisture content, and an R2CV of 0.50 and an RMSECV of 7.5 mg/g for tebuthiuron content. This analytical technique could be used to optimize the manufacturing process and to reduce the costs of post-manufacturing quality assurance.

Thixotropic behavior describes a time-dependent rheological behavior characterized by reversible changes. Fresh cementitious materials often require thixotropic behavior to ensure sufficient workability and proper casting without vibration. Non-thixotropic behavior induces a workability loss. Cementitious materials cannot be considered as an ideal thixotropic material due to cement hydration, which leads to irreversible changes. However, in some cases, cement paste may demonstrate thixotropic behavior during the dormant period of cement hydration. The aim of the work presented by El Bitouri and Azêma [11] was to propose an approach able to quantify the contribution of cement hydration during the dormant period and to examine the conditions under which the cement paste may display thixotropic behavior. The proposed approach consists of a succession of stress growth procedures that allow the static yield stress to be measured. For an inert material, such as a calcite suspension, the structural build-up is due to the flocculation induced by attractive Van der Waals forces. This structural build-up is reversible. For cement paste, there is a significant increase in the static yield stress due to cement hydration. The addition of superplasticizer allows the thixotropic behavior to be maintained during the first hours due to its retarding effect. However, an increase in the superplasticizer dosage leads to a decrease in the magnitude of the Van der Waals forces, which can erase the thixotropic behavior.

Biometrics deals with the recognition of humans based on their unique physical characteristics. It can be based on facial, iris, fingerprint or DNA identification. In Ref. [12], Hafeez et al. considered the iris as a source of biometric verification as it is a unique part of the eye that can never be altered, and it remains the same throughout an individual's life. The authors proposed an improved iris-recognition system including image registration as a main step, as well as an edge-detection method for feature extraction. This PCA-based method was also proposed as an independent iris-recognition method based on a similarity score. The experiments conducted using the developed database demonstrate that the first proposed system reduced the computation time to 6.56 s, and it improved the accuracy to 99.73, while the PCA-based method has less accuracy than this system.

The increasing implementation of distributed renewable generation lead to the need for Citizen Energy Communities. Citizen Energy Communities may be able to be active market players and to solve local imbalances. The liberalization of the electricity sector caused wholesale and retail competition, which is a natural evolution of electricity markets. In retail competition, retailers and communities compete to sign bilateral contracts with consumers. In wholesale competition, producers, retailers and communities can submit bids to spot markets, where the prices are volatile, or can sign bilateral contracts to hedge against spot price volatility. To participate in those markets, communities have to rely on risky consumption forecasts, hours ahead of real-time operation. So, as Balance Responsible Parties, they may pay penalties for real-time imbalances. This paper proposed and tested a new strategic bidding process in spot markets for communities of consumers. The strategic bidding process is composed of a forced forecast methodology for day-ahead and short-run trends for intraday forecasts of consumption. This paper developed by Algarvio [13] also presents a case study where energy communities submit bids to spot markets to satisfy their members using the strategic bidding process. The results show that bidding at short-term markets leads to lower forecast errors than bidding at long and medium-term markets. Better forecast accuracy leads to better fulfillment of a community's programmed dispatch, resulting in lower imbalances and control reserve needs for power system balance. Furthermore, by being active market players, energy communities may save around 35% in their electrical energy costs when compared with retail tariffs.

Corn is an example of an agricultural grain with a specific combustibility level and can promote smoldering fires during storage. The interesting contribution of the study in Ref. [14] conducted an experimental design to numerically evaluate how three parameters, namely particle size, moisture, and air ventilation, influence the smoldering velocity. The work methodology was based on Minitab's experimental design, which defined the number of experiments. First, a pile of corn was heated by a hot plate, and a set of thermocouples registered all temperature variations. Then, a full-factorial experiment was implemented in Minitab to analyze the smoldering, which provided a mathematical equation to represent the smoldering velocity. The results indicate that particle size is the most influential factor in the reaction, with 35% and 45% variation between the dried and wet samples. Moreover, comparing the effect of moisture between corn flour and corn powder samples, variations of 19% and 31% were observed; additionally, analyzing the ventilation as the only variant, the authors noticed variations of 15% and 17% for dried and wet corn flour, respectively, and 27% and 10% for dried and wet corn powder, respectively.

Currently, tissue product producers try to meet consumers' requirements to retain their loyalty. In perforated products, such as toilet paper, these requirements involve the paper being portioned along the perforation line and not outside of it. Thus, it becomes necessary to enhance the behavior of the perforation line in perforated tissue papers. The study presented by Costa Vieira et al. [15] aimed to verify if the perforation line for 0° (the solution found in commercial perforated products) is the best solution to maximize the perforation efficiency. A finite element (FE) simulation was used by the authors to validate the experimental data, where the deviations from the experiments were 5.2% for the case with a 4 mm perforation length and 8.8% for a perforation of 2 mm, and to optimize the perforation efficiency using the genetic algorithm while considering two different cases. In

the first case, the blank distance and the perforation line angle were varied, with the best configuration being achieved with a blank distance of 0.1 mm and an inclination angle of 0.56°. For the second case, the blank distance was fixed to 1.0 mm and the only variable to be optimized was the inclination angle of the perforation line. It was found that the best angle inclination was 0.67°. In both cases, it was verified that a slight inclination in the perforation line will favor partitioning and, therefore, the perforation efficiency.

Telecommunication companies collect a deluge of subscriber data without retrieving substantial information. An exploratory analysis of these types of data will facilitate the prediction of varied information that can be geographical, demographic, financial or other. Predictions can therefore be an asset in the decision-making process of telecommunications companies, but only if the information retrieved follows a plan with strategic actions. An exploratory analysis of subscriber data was implemented in this research to predict subscriber usage trends based on historical time-stamped data [16]. The predictive outcome was unknown but approximated using the data at hand. The author used 730 data points selected from Insights Data Storage (IDS). These data points were collected from the hourly statistic traffic table and subjected to exploratory data analysis to predict the growth in subscriber data usage. The Auto-Regressive Integrated Moving Average (ARI-MA) model was used for the forecasting. In addition, the author used the normal Q-Q, correlogram and standardized residual metrics to evaluate the model. This model showed a *p*-value of 0.007. This result supports the hypothesis predicting an increase in subscriber data growth. The ARIMA model predicted a growth of 3 Mbps, with a maximum data usage growth of 14 Gbps. In the experiment, ARIMA was compared with the Convolutional Neural Network (CNN) and achieved the best results with the UGRansome data. The ARIMA model performed better, with an execution speed that was faster by a factor of 43 for more than 80,000 rows. On average, it takes 0.0016 s for the ARIMA model to execute one row and 0.069 s for the CNN to execute the same row, thus making the ARIMA 43× (0.0690.0016) faster than the CNN model. These results provide a road map for predicting subscriber data usage so that telecommunication companies can be more productive in improving their Quality of Experience (QoE). This study provides a better understanding of the seasonality and stationarity involved in subscriber data usage's growth, exposing new network concerns and facilitating the development of novel predictive models.

Barbosa et al. [17] performed 2D micrometric mapping of different elements in different grain size fractions of the soil of a sample using the X-ray microfluorescence (μ-XRF) technique. The sample was collected in the vicinity of São Domingos, an old mine of massive sulphide minerals located in the Portuguese Iberian Pyrite Belt. As expected, elemental high-grade concentrations of distinct metals and metalloids dependent on the existing natural geochemical anomaly were detected. The authors developed a clustering and k-means statistical analysis considering red–green–blue (RGB) pixel proportions in the produced 2D micrometric image maps, allowing the authors to identify elementary spatial distributions in 2D. The results evidence how elemental composition varies significantly at the micrometric scale per grain-size class and how chemical elements present irregular spatial distributions due to direct dependence on the distinct mineral spatial distributions. Due to this fact, the elemental compositions are more different in coarser grain-size classes, whereas the grinding-milled fraction does not always represent the average of all partial grain-size fractions. Despite the complexity of the performed analysis, the achieved results evidence the suitability of μ-XRF in characterizing natural, heterogeneous, granular soils samples at the micrometric scale, being a very promising high-resolution investigation technique.

In Ref. [18], the author proposed an efficient method of identifying important neurons that are related to an object's concepts by mainly considering the relationship between these neurons and their object concept or class. He first quantified the activation values among neurons, based on which histograms of each neuron were generated. Then, the obtained histograms were clustered to identify the neurons' importance. A network-wide holistic approach was also introduced to efficiently identify important neurons and their

influential connections to reveal the pathway of a given class. The influential connections, as well as their important neurons, were carefully evaluated to reveal the sub-network of each object's concepts. The experimental results on the MNIST and Fashion MNIST datasets show the effectiveness of the proposed method.

Safety reporting has long been recognized as critical to reducing safety occurrences by identifying issues early enough such that they can be remedied before an adverse outcome. The study in Ref. [19] examines safety occurrence reporting amongst a sample of 92 New Zealand civilian uncrewed aircraft users. An online survey was created to obtain the types of occurrences that these users have had, how (if at all) these are reported, and why participants did or did not report using particular systems. This work focused on seven types of occurrences that have been highlighted by the Civil Aviation Authority of New Zealand as being reportable using the CA005RPAS form, the template for reporting un-crewed aircraft occurrences to authorities. The number of each type of occurrence was recorded, as well as what percentage of occurrences were reported using the CA005RPAS form, reported using an internal reporting system or not reported. Qualitative questions were used by the authors to understand why participants did or did not report using particular systems. The categorical and numerical data were analyzed using Chi-Squared Tests of Independence, Kruskal–Wallis H Tests and Mann–Whitney U Tests. The qualitative data were analyzed using thematic analysis. The findings reveal that 85.72% of reportable safety occurrences went unreported by pilots, with only 2.74% of occurrences being self-reported by pilots using the CA005RPAS form. The biggest reason for not reporting was that the user did not perceive the occurrence as being serious enough, with not being aware of reporting systems and not being legally required to report also being major themes. Significant differences were also observed by the authors between user groups, thus leading to suggestions on policy changes to improve safety occurrence reporting, such as making reporting compulsory, setting minimum training standards, having an anonymous and non-punitive reporting system, and working with member-based organizations.

Using surrogate safety measures is a common method to assess safety on roadways. Surrogate safety measures allow for a proactive safety analysis; the analysis is performed prior to crashes occurring. This allows for safety improvements to be implemented proactively to prevent crashes, and the associated injuries and property damage. Existing surrogate safety measures primarily rely on data generated by microsimulations, but the advent of connected vehicles has allowed for the incorporation of data from actual cars into safety analyses with surrogate safety measures. In the study by Khanal and Edelmann [20], commercially available connected vehicle data were used to develop crash-prediction models for crashes at intersections and segments in Salt Lake City, Utah. Harsh braking events were identified and counted within the area of influence, inclusive of sixty intersections and thirty segments, and then used to develop crash-prediction models. Other intersection characteristics were considered as regressor variables in the models, such as the intersection's geometric characteristics, connected vehicle volumes, and the presence of schools and bus stops in the vicinity. Statistically significant models were developed by the authors, and these models may be used as a surrogate safety measure to analyze intersection safety proactively. The findings are applicable to Salt Lake City, but similar research methods may be employed by other researchers to determine whether these models are applicable in other cities and to determine how the effectiveness of this method endures through time.

Buried charges pose a serious threat to both civilians and military personnel. It is well established that soil properties have a large influence on the magnitude and variability of loading from explosive blasts in buried conditions. In Ref. [21], work was undertaken to improve techniques for processing pressure data from discrete measurement apparatuses; this was performed by testing truncation methodologies and the area integration of impulses, accounting for the particle size distribution (PSD) of the soils used in testing. Two experimental techniques were investigated by Waddoups et al. to allow for a comparison between a global impulse capture method and an area-integration procedure from a Hopkinson Pressure Bar array. This paper explores an area-limiting approach, based on particle

size distribution, as a possible approach to derive a better representation of the loading on the plate, thus demonstrating that the spatial distribution of a loading over a target can be related to the PSD of the confining material.

The rapidly increasing number of drones in the national airspace, including those for recreational and commercial applications, has raised concerns regarding misuse. Autonomous drone-detection systems offer a probable solution to overcoming the issue of potential drone misuse, such as drug smuggling, violating people's privacy, etc. However, detecting drones can be difficult, due to similar objects being in the sky, such as airplanes and birds. In addition, automated drone detection systems need to be trained with ample amounts of data to provide high accuracy. Real-time detection is also necessary, but this requires highly configured devices such as a graphical processing unit (GPU). The work in Ref. [22] sought to overcome these challenges by proposing a one-shot detector called You Only Look Once version 5 (YOLOv5), which can train the proposed model using pre-trained weights and data augmentation. The trained model was evaluated using mean average precision (mAP) and recall measures. The model achieved a 90.40% mAP, a 21.57% improvement over our previous model that used You Only Look Once version 4 (YOLOv4), and was tested on the same dataset.

The paper in Ref. [23] introduces a novel approach to leveraging features learned from both supervised and self-supervised paradigms, to improve image classification tasks, specifically for vehicle classification. Two state-of-the-art self-supervised learning methods, DINO and data2vec, were evaluated and compared by the authors for their representation learning of vehicle images. The former contrasts local and global views, while the latter uses masked prediction on multiple layered representations. In the latter case, supervised learning is employed to finetune a pretrained YOLOR object detector for detecting vehicle wheels, from which definitive wheel positional features are retrieved. The representations learned from these self-supervised learning methods were combined with the wheel positional features for the vehicle classification task. Particularly, a random wheel masking strategy was utilized to finetune the previously learned representations in harmony with the wheel positional features during training of the classifier. The experiments made by the authors show that the data2vec-distilled representations, which are consistent with our wheel masking strategy, outperformed the DINO counterpart, resulting in a celebrated Top-1 classification accuracy of 97.2% for classifying the 13 vehicle classes defined by the Federal Highway Administration.

Many current bioinformatics algorithms have been implemented in parallel programming codes. Some of them have already reached the limits imposed by Amdahl's law, but many can still be improved. Blaszynski and Bielecki [24] presented an approach that allows for the generation of a high-performance code for calculating the number of RNA pairs. The approach allows for the generation of a parallel tiled code with maximum-dimension tiles, which for the discussed algorithm, is in 3D. The experiments carried out on two modern multi-core computers, an Intel(R) Xeon(R) Gold 6326 (2.90 GHz, 2 physical units, 32 cores, 64 threads and 24 MB Cache) and Intel(R) i7(11700KF (3.6 GHz, 8 cores, 16 threads and 16 MB Cache), demonstrate a significant increase in performance and scalability of the generated parallel tiled code. For the Intel(R) Xeon(R) Gold 6326 and Intel(R) i7, target code speedup increased linearly with an increase in the number of threads. The approach presented in this paper to generate a target code can be used by programmers to generate target parallel tiled codes for other bioinformatics codes for which the dependence patterns are similar to those of the code implementing the counting algorithm.

Malware classification is a well-known problem in computer security. Hyperparameter optimization (HPO) using covering arrays (CAs) is a novel approach that can enhance machine learning classifier accuracy. The tuning of machine learning (ML) classifiers to increase classification accuracy is needed nowadays, especially with newly evolving malware. Four machine learning techniques were tuned using cAgen, a tool for generating covering arrays. The results included in Ref. [25] show that cAgen is an efficient approach to achieving the optimal parameter choices for ML techniques. Moreover, the covering

array shows significant promise, especially cAgen with regard to the ML hyperparameter optimization community, malware detector community and overall security testing.

Musical timbre is a phenomenon of auditory perception that allows for the recognition of musical sounds. The recognition of musical timbre is a challenging task because the timbre of a musical instrument or sound source is a complex and multifaceted phenomenon that is affected by a variety of factors, including the physical properties of the instrument or sound source, the way it is played or produced, and the recording and processing techniques used. Gonzalez and Prati [26] explored an abstract space with 7 dimensions formed by the fundamental frequency and FFT-Acoustic Descriptors in 240 monophonic sounds from the Tinysol and Good-Sounds databases, corresponding to the 4th octave of the transverse flute and clarinet. This approach allowed the authors to unequivocally define a collection of points and, therefore, a timbral space (Category Theory) that allows for different sounds of any type of musical instrument with its respective dynamics to be represented as a single characteristic vector. The geometric distance allows for studying the timbral similarity between audios of different sounds and instruments or between different musical dynamics and datasets. Additionally, a machine learning algorithm that evaluates timbral similarities through Euclidean distances in the abstract space of seven dimensions was proposed by them. The authors conclude that the study of timbral similarity through geometric distances allowed us to distinguish between audio categories of different sounds and musical instruments, between the same type of sound and an instrument with different relative dynamics, and between different datasets.

When studying horizontally inhomogeneous media, it is necessary to apply tensor modifications of electromagnetic soundings. The use of tensor measurements is of particular relevance in near-surface electrical prospecting because the upper part of the geological section is usually more heterogeneously than the deep strata. In the Enviro-MT system designed for the controlled-source radiomagnetotelluric (CSRMT) sounding method, two mutually perpendicular horizontal magnetic dipoles (two vertical loops) are used for tensor measurements. In Ref. [27], a variant of the CSRMT method with two horizontal electrical dipole sources (two transmitter lines) was proposed. The advantage of such sources is an extended frequency range of 1–1000 kHz in comparison with a frequency range of 1–12 kHz for the Enviro-MT system, the greater operational distance (up to 3–4 km compared to 600–800 m), and the ability to measure the signal at the fundamental frequency and its subharmonics. To implement tensor measurements with the equipment of the CSRMT method described in this work, a technique inducing time-varying polarization of the electromagnetic field (rotating field) was developed by the authors based on the use of two transmitters with slightly different current frequencies and two mutually perpendicular transmitter lines grounded at the ends. In this way, the authors made it possible to change the direction of the electrical and magnetic field polarization continuously. This approach allows for the realization of a technique for tensor measurements using a new modified CSRMT method. In permafrost areas, hydrogenic taliks are widespread. These local objects are important in the context of the study of environmental changes in the Arctic and can be successfully explored using the tensor CSRMT method. For numerical modeling, a 2D model of the talik was used. The results of the interpretation of the synthetic data showed the advantage of bimodal inversion using the CSRMT curves of both TM and TE modes compared with separate inversion of the TM and TE curves. These new data demonstrate the prospects of the tensor CSRMT method in the study of permafrost regions. The problems that can be solved using the CSRMT method in the Arctic permafrost regions are also presented and discussed.

The sugar and alcohol sectors are dynamic as a result of climate alterations, the introduction of sugarcane varieties and new technologies. Despite these factors, Brazil stands out as the main producer of sugarcane worldwide, being responsible for 45% of the production of fuel ethanol. Several varieties of sugarcane have been developed in the past few years to improve features of the plant. This, however, led to the challenge of which variety producers should choose to plant on their property. In order to support

this process, the research in Ref. [28] aims to test the application of the analytic hierarchy process (AHP) method to support producers in selecting which sugarcane variety to plant on their property. To achieve this goal, the authors relied on a single case study performed on a rural property located inland of São Paulo state, the main producer state in Brazil. The results demonstrate the feasibility of the used approach, specifically owing to the adaptability of the AHP method.

With the rapid development of modern technologies, autonomous or robotic construction sites are becoming a new reality in civil engineering. Despite various potential benefits of the automation of construction sites, there is still a lack of understanding of their complex nature when combining physical and cyber components in one system. A typical approach to describing complex system structures is to use tools of abstract mathematics, which provide a high level of abstraction, allowing for a formal description of the entire system while omitting non-essential details. Therefore, in Ref. [29], autonomous construction is formalized using categorical ontology logs enhanced by abstract definitions of individual components of an autonomous construction system. In this context, followed by a brief introduction to category theory and ologs, exemplary algebraic definitions were given as a basis for the olog-based conceptual modelling of autonomous construction systems. As a result, any automated construction system can be described without providing exhausting detailed definitions of the system components. Existing ologs can be extended, contracted or revised to fit the given system or situation. To illustrate the descriptive capacity of ologs, a lattice of representations was presented by the authors. The main advantage of using the conceptual modelling approach presented in this paper is that any given real-world or engineering problem could be modelled with a mathematically sound background.

Hypotrochoidal profile contours have been produced in industrial applications in recent years using two-spindle processes, and they are considered effective high-quality solutions for form-fit shaft and hub connections. This study presented by Ziaei [30] mainly concerns analytical approaches to determining the stresses and deformations in hypotrochoidal profile shafts due to pure bending loads. The formulation was developed according to bending principles using the mathematical theory of elasticity and conformal mappings. The loading was further used to investigate the rotating bending behavior. The stress factors for the classical calculation of maximum bending stresses were also determined for all those profiles presented and compiled into the German standard DIN3689-1 for practical applications. The results were compared with the corresponding numerical and experimental results, and very good agreement was found. This study contributes to further refinement of the current DIN3689 standard.

Shell structures have a rich family of boundary layers including internal layers. Each layer has its own characteristic length scale, which depends on the thickness of the shell. Some of these length scales are long, something that is not commonly considered in the literature. In Ref. [31], three types of long-range layers are demonstrated over an extensive set of simulations. The author indicates that the observed asymptotic behavior is consistent with theoretical predictions. These layers are shown to also appear on perforated structures underlying the fact these features are properties of the elasticity equations and not dependent on effective material parameters. The simulations were performed using a high-order finite element method implementation of the Naghdi-type dimensionally reduced shell model. Additionally, the effect of the perforations on the first eigenmodes is discussed. Finally, one possible model for buckling analysis is outlined.

Any stretch of coastline requires protection when the rate of erosion exceeds a certain threshold and seasonal coastal drift fluctuations fail to restore balance. Coast erosion can be caused by natural, synthetic or a combination of events. Severe storm occurrences, onshore interventions liable for sedimentation, wave action on the coastlines and rising sea levels caused by climate change are instances of natural factors. The protective methods used to counteract or prevent coastal flooding are categorized as hard and soft engineering techniques. The paper in Ref. [32] is based on extensive reviews and analyses of scientific publications. In order to establish a foundation for the selection of appropriate adaptation

measures for coastal protection, this study compiled the literature on a combination of both natural and artificial models using mangrove trees and polymer-based models' configurations and their efficiency in coastal flooding. Mangrove roots occur naturally and cannot be manipulated, unlike artificial model configuration, which can be structurally configured with different hydrodynamic properties. Artificial models may lack the real structural features and hydrodynamic resistance of the mangrove root that it depicts, and this can reduce its real-life application and accuracy.

In the final manuscript [33], presented as a communication, the author indicates that unmanned aircraft systems (UASs), commonly referred to as drones, are an emerging technology that has changed the way that many industries conduct business. Precision agriculture is one industry that has consistently been predicted to be a major locus of innovation for UASs. However, this has not been the case globally. The agricultural aircraft sector in the United States was used as a case study to consider different metrics in evaluating UAS adoption, including a proposed metric, the normalized UAS adoption index. In aggregate, UAS operators only make up 5% of the number of agricultural aircraft operators. However, the annual number of new UAS operators exceeded that of manned aircraft operators in 2022. When used on a state-by-state basis, the normalized UAS adoption index shows that there are regional differences in UAS adoption, with western and eastern states having higher UAS adoption rates and central states having significantly lower UAS adoption rates. This has implications for UAS operators, manufacturers and regulators as this industry continues to develop at a rapid pace.

**Conflicts of Interest:** The author declares no conflict of interest.

## References


1. Kordas, G. All-Purpose Nano- and Microcontainers: A Review of the New Engineering Possibilities. *Eng* **2022**, *3*, 554–572. [CrossRef]
2. Jombo, G.; Zhang, Y. Acoustic-Based Machine Condition Monitoring—Methods and Challenges. *Eng* **2023**, *4*, 47–79. [CrossRef]
3. Soto, E.A.; Borman, L.B.; Wollega, E.; Leon-Salas, W.O. Analysis of Grid Disturbances Caused by Massive Integration of Utility Level Solar Power Systems. *Eng* **2022**, *3*, 236–253. [CrossRef]
4. Khemani, V.; Azarian, M.H.; Pecht, M.G. Efficient Identification of Jiles-Atherton Model Parameters Using Space-Filling Designs and Genetic Algorithms. *Eng* **2022**, *3*, 364–372. [CrossRef]
5. Lee, D.; Diaconeasa, M.A. Preliminary Siting, Operations, and Transportation Considerations for Licensing Fission Batteries in the United States. *Eng* **2022**, *3*, 373–386. [CrossRef]
6. Sharafeldin, M.; Farid, A.; Ksaibati, K. Investigating the Impact of Roadway Characteristics on Intersection Crash Severity. *Eng* **2022**, *3*, 412–423. [CrossRef]
7. Andersen, B.; Hou, J.; Godfrey, A.T.; Kropaczek, D. A Novel Method for Controlling Crud Deposition in Nuclear Reactors Using Optimization Algorithms and Deep Neural Network Based Surrogate Models. *Eng* **2022**, *3*, 504–522. [CrossRef]
8. Zayed, E.; El-Horbaly, M.; Alngar, M.E.M.; El-Shater, M. Dispersive Optical Solitons for Stochastic Fokas-Lenells Equation with Multiplicative White Noise. *Eng* **2022**, *3*, 523–540. [CrossRef]
9. Seits, F.; Kurmi, I.; Bimber, O. Evaluation of Color Anomaly Detection in Multispectral Images for Synthetic Aperture Sensing. *Eng* **2022**, *3*, 541–553. [CrossRef]
10. Johnson, J.B.; Farquhar, H.; Ismay, M.; Naiker, M. Infrared Spectroscopy for the Quality Control of a Granular Tebuthiuron Formulation. *Eng* **2022**, *3*, 596–619. [CrossRef]
11. El Bitouri, Y.; Azéma, N. On the "Thixotropic" Behavior of Fresh Cement Pastes. *Eng* **2022**, *3*, 677–692. [CrossRef]
12. Hafeez, H.; Zafar, N.; Asad Abbas, C.; Elahi, H.; Osama Ali, M. Real-Time Human Authentication System Based on Iris Recognition. *Eng* **2022**, *3*, 693–708. [CrossRef]
13. Algarvio, H. Strategic Participation of Active Citizen Energy Communities in Spot Electricity Markets Using Hybrid Forecast Methodologies. *Eng* **2023**, *4*, 1–14. [CrossRef]
14. Rosa, A.C.; Teixeira, I.; Lacasta, A.M.; Haurie, L.; Soares, C.A.P.; Tam, V.W.Y.; Haddad, A. Experimental Design for the Propagation of Smoldering Fires in Corn Powder and Cornflour. *Eng* **2023**, *4*, 15–30. [CrossRef]
15. Costa Vieira, J.; Costa Vieira, A.; Ribeiro, M.L.; Fladeiro, P.T.; Costa, A.P. Angle of the Perforation Line to Optimize Partitioning Efficiency on Toilet Papers. *Eng* **2023**, *4*, 80–91. [CrossRef]
16. Nkongolo, M. Using ARIMA to Predict the Growth in the Subscriber Data Usage. *Eng* **2023**, *4*, 92–120. [CrossRef]
17. Barbosa, S.; Dias, A.; Pacheco, M.; Pessanha, S.; Almeida, J.A. Investigating Metals and Metalloids in Soil at Micrometric Scale Using μ-XRF Spectroscopy—A Case Study. *Eng* **2023**, *4*, 136–150. [CrossRef]
18. Alqahtani, A.M. Network Pathway Extraction Focusing on Object Level. *Eng* **2023**, *4*, 151–158. [CrossRef]

19. Walton, C.N.; Henderson, I.L. Safety Occurrence Reporting amongst New Zealand Uncrewed Aircraft Users. *Eng* **2023**, *4*, 236–258. [CrossRef]
20. Khanal, M.; Edelmann, N. Application of Connected Vehicle Data to Assess Safety on Roadways. *Eng* **2023**, *4*, 259–275. [CrossRef]
21. Waddoups, R.; Clarke, S.; Tyas, A.; Rigby, S.; Gant, M.; Elgy, I. An Approach to Quantifying the Influence of Particle Size Distribution on Buried Blast Loading. *Eng* **2023**, *4*, 319–340. [CrossRef]
22. Aydin, B.; Singha, S. Drone Detection Using YOLOv5. *Eng* **2023**, *4*, 416–433. [CrossRef]
23. Ma, S.; Yang, J.J. Image-Based Vehicle Classification by Synergizing Features from Supervised and Self-Supervised Learning Paradigms. *Eng* **2023**, *4*, 444–456. [CrossRef]
24. Blaszynski, P.; Bielecki, W. High-Performance Computation of the Number of Nested RNA Structures with 3D Parallel Tiled Co. *Eng* **2023**, *4*, 507–525. [CrossRef]
25. ALGorain, F.T.; Clark, J.A. Covering Arrays ML HPO for Static Malware Detection. *Eng* **2023**, *4*, 543–554. [CrossRef]
26. Gonzalez, Y.; Prati, R.C. Similarity of Musical Timbres Using FFT-Acoustic Descriptor Analysis and Machine Learning. *Eng* **2023**, *4*, 555–568. [CrossRef]
27. Saraev, A.K.; Shlykov, A.A.; Bobrov, N.Y. Tensor CSRMT System with Horizontal Electrical Dipole Sources and Prospects of Its Application in Arctic Permafrost Regions. *Eng* **2023**, *4*, 569–580. [CrossRef]
28. Schiavon, L.L.P.; Lima, P.A.B.; Crepaldi, A.F.; Mariano, E.B. Use of the Analytic Hierarchy Process Method in the Variety Selection Process for Sugarcane Planting. *Eng* **2023**, *4*, 602–614. [CrossRef]
29. Legatiuk, D.; Luckey, D. Formalising Autonomous Construction Sites with the Help of Abstract Mathematics. *Eng* **2023**, *4*, 799–815. [CrossRef]
30. Ziaei, M. Bending and Torsional Stress Factors in Hypotrochoidal H-Profiled Shafts Standardised According to DIN 3689-1. *Eng* **2023**, *4*, 829–842. [CrossRef]
31. Hakula, H. On Long-Range Characteristic Length Scales of Shell Structures. *Eng* **2023**, *4*, 884–902. [CrossRef]
32. Amos, D.; Akib, S. A Review of Coastal Protection Using Artificial and Natural Countermeasures—Mangrove Vegetation and Polymers. *Eng* **2023**, *4*, 941–953. [CrossRef]
33. Rodriguez, R., III. Measuring the Adoption of Drones: A Case Study of the United States Agricultural Aircraft Sector. *Eng* **2023**, *4*, 977–983. [CrossRef]