



Introductory notes for the Acta IMEKO Special Issue on 'Innovative Signal Processing and Communication Techniques for Measurement and Sensing Systems'

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Dear Readers,

The rapid developments in signal processing and communication techniques enable measurement and sensing systems more accurate and facilitates high resolution sensing data output. This broadens the market prospects and demands, as a result the measurement and sensing systems become a key element in any complex engineering systems. Innovations in signal processing and communication methods make the sensing systems fast, intelligent and knowledge-based systems. These innovations enable the measurement and sensing systems higher accuracy, faster detection ability and lower the implementation cost. This has led to the possibility of development of dynamic, smart sensing systems. The scope of this Special Issue will focus on innovative signal processing and communication techniques for measurement and sensing systems by identifying new perspectives and highlighting potential research issues and challenges. Specifically, this special issue will demonstrate how the emerging technologies could be used in future smart sensing systems. The topics of interest in the context of measurement and sensing systems includes: Antenna measurements, Artificial Intelligence, Beam forming techniques, Body area networks, Embedded processors, Image sensors and processing, Internet of Things, Knowledge based systems, Machine learning algorithms, medical signal analysis, Sensor data processing, VLSI architectures and many more thrust areas.

This Special issue consists of 15 full length papers discussed in the context of measurement and sensing suitable for publishing in Acta IMEKO.

In the paper 'Mitigation of spectrum sensing data falsification attack using multilayer perception in cognitive radio networks' the issue of spectrum scarcity and low spectrum utilization in wireless communication systems is addressed. Malicious users receive

spectrum sensing data, resulting in inaccurate global decisions about spectrum availability. This work proposes multilayer perception and then measures statistical aspects of incoming signals to identify false data in cooperative spectrum sensing.

The paper titled 'Evaluation on effect of alkaline activator on compaction properties of red mud stabilized by ground granulated blast slag' details about virgin red mud (RM), ground granulated blast slag (GGBS), stabilized RM, and alkaline activated GGBS stabilized RM samples, comprehensive compaction tests were performed. The effect of an alkaline activator on the compaction properties of GGBS stabilized RM is investigated in this research. The compaction curves indicated a substantial difference in maximum dry density and optimal moisture content with the modification of GGBS percentage and varied ratios of NaOH to Na₂SiO₃ when standard and modified proctor compaction tests were conducted for various combinations of RM and GGBS.

The paper 'Multipath routing protocol based on backward routing with optimal fuzzy logic in medical telemetry systems for physiological data measurements,' by Suryadevara Kranthi et al., proposes a novel safe multi-way approach for trustworthy data transfer that is dependent on service quality. Multi-path routing is also supported by the Ad Hoc on Demand Backward Routing protocol with Optimal Fuzzy Logic (OFL). By generating rules in OFL and thus choosing an optimal rule, the hybridization of the bat optimization strategy delivers the best route. The final delay, the packet delivery ratio, and other criteria are used to assess the efficiency of the proposed technique.

The fourth paper 'A machine learning based sensing and measurement framework for timing of volcanic eruption and categorization of seismic data' authored by Vijay Souri Maddila et al., investigates the circumstances and factors that govern the volcanic explosive ejection are unclear, and there is currently no efficient approach



to predict when a volcanic explosive ejection will terminate. Create a decisiveness measure D to analyze the uniformity of the groups supplied by these machine learning models using controlled machine learning approaches such as Support Vector Machine (SVM), Random Forest (RF), Logistic Regression (LR), and Gaussian Process Classifiers (GPC). The measured end-date derived by seismic information classification for both volcanic systems is two to four months later than the end-dates determined by the earliest instance of visual eruption.

The paper *'Fire SM: new dataset for anomaly detection of fire in video surveillance,'* seeks to aid the growth of this particular research by including the Fire SM dataset, which is a large and diverse new dataset. Furthermore, a precise estimation in early fire detection utilising an indicator, Average Precision, can yield extra information. In this paper, two existing common methodologies were compared to different anomaly detection methods that give an efficient solution to discover Fire incidents.

In the paper *'Extended buffer zone algorithm to reduce rerouting time in biotelemetry systems using sensing,'* routing strategies for Mobile Adhoc Networks (MANETs) with connection breakdowns induced by frequent node movement, measurement, and a dynamic network topology are discussed. Many ideas have been presented by researchers to shorten the rerouting time. Buffer zone routing (BZR) is one such solution, which splits a node transmission region into a safe zone adjacent to the node and a hazardous zone towards the broadcast range's end. The energy consumption of the nodes is reduced when routing decisions are made promptly. Transfer time is lowered and routing efficiency is improved in the wider BZR safe region. It corrects flaws in the current algorithm and fills in gaps, reducing the time necessary for MANET rerouting.

In the paper *'Multi-input multi-output antenna measurements with super wide bandwidth for wireless applications using isolated T stub and defected ground structure,'* Pradeep Vinaik Kodavanti et al., offers the concept of faulty ground structures for improving the antenna's radiation properties, particularly in a multi-input multi-output (MIMO) arrangement. In both single and array configurations, the suggested antenna architecture with slightly flared out feed system is constructed and analyzed with defective ground. The T stub is a T-shaped stub that was employed in this project with a defective ground construction. To improve the MIMO configuration features, a T stub is introduced, as well as a faulty ground. Simulations are run on an electromagnetic modeling tool, and parameters such as reflection coefficient, voltage standing wave ratio, gain, radiation pattern, and current distribution plots are measured.

In the paper *'Analysis of multiband rectangular patch antenna with defected ground structure using reflection coefficient measurement,'* the Computer Simulation Technology (CST) Microwave Studio software is used to develop and simulate a new quad band antenna that can function in four different frequency bands. Various parameters were improved using parametric analysis to improve the antenna's performance. Various antenna parameters have to be measured throughout this investigation.

In the paper entitled *'Analysis of peak-to-average power ratio in filter bank multicarrier with offset quadrature amplitude modulation systems using partial transmit sequence with shuffled frog leap optimization*

technique' addressed about the filter bank multicarrier with offset quadrature amplitude modulation (FBMC-OQAM), which tackles the problem of low Adjacent Channel Leakage Ratio, has recently stimulated the interest of numerous researchers. However, the FBMC system's energy measuring efficiency is harmed by the problem of high Peak-to-Average Power Ratio (PAPR) measurement. This paper proposes the Partial Transmit Sequence (PTS) with shuffled frog leap (SFL) phase optimization method to reduce the larger PAPR measurement, which is a major drawback of the filter bank multicarrier with offset quadrature amplitude modulation (FBMC-OQAM) system. MATLAB is used to measure the experimental parameters and assess the results.

The paper *'Beamforming in Cognitive Radio Networks using Partial Update Adaptive Learning Algorithm'* investigates cognitive radio technology as a means of increasing bandwidth efficiency. Frequency that isn't used in any way will be employed in this cognitive radio by utilising some of the most powerful resources. One of the key advantages of cognitive radio signals is that they can identify different channels in the spectrum and change the frequencies that are often used. In this research, cognitive radio was developed utilising the beamforming approach, with power allocation as a strategy for the unlicensed transmitter that is completely based on sensing results. It is based on the status of the principal user in a different cognitive radio network, whereas an unlicensed transmitter uses a single antenna and changes the power transmitted.

In the paper, *'Efficient Deep Learning Based Data Augmentation Techniques for Enhanced Learning on Inadequate Medical Imaging Data,'* a unique strategy to data augmentation for medical imaging was developed, which could partially solve the problem of limited availability of Chest X-Ray data. On the original data, a pre-processing step was performed to reduce the image size from 1024x1024x1 to 128x128x1. From datasets generated by a Simple Generative Adversarial Network (GAN) and a Transfer Learning GAN, the CNN learnt considerably faster and had improved accuracy, and this could be a one-stop solution for the limited availability of Chest X-Ray data.

The paper *'Image Reconstruction Using Refined Res-UNet Model for MIR,'* proposes reconstruction of the input medical image, a unique content-based Res-UNet framework is proposed, which performs an efficient image retrieval task. ResNet50 is used as an encoder in the proposed work to conduct feature vector encoding. The proposed model's performance is assessed using the two benchmark datasets, IILD and VIA/ELCAP-CT. The suggested model outperforms traditional approaches, as evidenced by the comparison findings.

In the paper, *'Multilayer feature fusion using covariance for Remote Sensing Scene Classification,'* stacked covariance is a new technique for scene categorization utilising remote sensing data that combines visual information from various layers of a CNN. In the current Stacked Covariance (SC) based classification framework, feature extraction is conducted first using a pre-trained CNN model, followed by feature fusion using Covariance. Each feature is the covariance of two separate feature maps, and these features are used to classify data using SVM. The proposed SC approach regularly outperforms other classification methods and delivers better results.



University of Bridgeport Prof. Navarun Gupta presented a paper entitled, '*Spectrum Sensing using Energy Measurement in Wireless Telemetry Networks using Logarithmic Adaptive Learning*,' the spectrum sensing method is used to identify primary user signals in cognitive radios. The least logarithmic absolute difference (LLAD) algorithm, in which noise strengths are modified at licenced users' sensing points, is proposed to avoid interferences between primary and secondary users. Estimated noise signals are removed using the proposed approach. To determine the threshold value, the probability of detection (POD) and probability of false alarm (POFA) are assessed. By sharing the un-used spectrum, the proposed energy measurement-based spectrum sensing method is effective in remote health care monitoring and medical telemetry applications.

Finally, the paper '*Classification of Brain Tumours Using Artificial Neural Networks*,' deals with Magnetic Resonance (MR) brain Image for medical analysis and diagnosis. These images are typically measured in radiology departments to assess images of anatomy as well as the human body's general physiological processes. Magnetic resonance imaging measurements are employed using a strong magnetic field, its gradients, also radio waves to create

images of human organs in this process. Blood clots or damaged blood vessels in the brain can also be detected using an MR brain imaging. Artificial Neural Networks (ANN) are used to classify whether an MR brain image contains a benign or malignant tumor. Finally, ANN is used to classify the information into benign and malignant tumors. The major goal and purpose of the study is to determine if the tumors are benign or malignant.

We thank all the Authors who contributed to this special issue, as well as all the Reviewers, and special thanks and gratitude for Prof. Francesco Lamonaca, Acta IMEKO's Editor in Chief, for his tireless and patient assistance in making this special issue possible. At the same time, our sincere thanks are extended to Dr. Dirk Röske, Associate Editor, for his assistance and contribution at various levels in the production process.

I am honoured to have served as Guest Editor for this issue, and I hope that by doing so, we will be able to bring the recent advancements in the signal processing and communication techniques in the contest of measurement and sensing systems.

Md. Zia Ur Rahman,
Guest Editor.