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Introductory notes for the Acta IMEKO third issue 2023 General Track

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Section: EDITORIAL

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Dear Readers,

also this issue includes a General Track aimed to collect contributions that do not relate to a specific event. As Editor in Chief, it is my pleasure to give to you an overview of these papers, with the aim of encouraging potential authors to consider sharing their research through Acta IMEKO.

Fall of an elderly person often leads to serious injuries and perchance to death. Many falls occur in the home environment, and hence a reliable fall detection system that can raise alarms with minimum latency is a necessity. Wrist-worn accelerometer-based fall detection systems and multiple datasets are available, but few attempts have been made to analyse their accuracy and precision. Wherever the comparison does exist, it has been run on a cloud. Very few analysis of the models, convergence, and dataset analysis on Systems on a Chip (SoCs) has been attempted. In [1], Authors attempt to present why Machine Learning (ML) algorithms in their current state can not be run on existing SoCs. In particular, Authors looked at the effect of distance metrics and neighbours as well as the effect of feature extraction on the accuracies and the latencies.

Vacuum tube audio preamplifiers have recently found renewed interest. The study proposed in [2] recalls the main requirements that this type of equipment must meet and analyses an example. The experimental approach followed to measure performances is described. These performances are exposed, and the associated uncertainties are determined.

The paper in [3] presents the design, characterization, and traceability of reference solar panel modules for determining the performance of photovoltaic (PV) modules at standard test conditions (STC). The research introduces an advanced experimental system based on a class AAA pulsed solar simulator to measure the radiometric, electrical performances, and efficiency of PV modules. I-V/P characteristics of three PV modules at different STCs and the associated uncertainty budget of the system were estimated. I-V characteristics and associated parameters including I_{sc}, V_{oc}, P_{max}, FF, and efficiency were measured. The radiometric and electrical traceability were discussed, and the relative expanded combined uncertainties were concluded to be 1.62 % (I_{sc}), 0.42 % (V_{oc}), 2.05 % (P_{max}), and 2.5% (η), with a coverage factor $k = 2$. Reference solar panel modules were also used on-site to test the performance of large PV panels.

During an ongoing epidemic, especially in the case of a new agent, data are partial and sparse, also affected by external factors, such as climatic effects or readiness and response capability of healthcare structures. Despite that, the Authors in [4] showed how, under some universality assumptions, it is possible to extract strategic insights by modelling the pandemic through a probabilistic Polya urn scheme. Adopting a Polya framework, Authors provided both the distribution of infected cases and the asymptotic estimation of the incidence rate, showing that data are consistent with a general underlying process at different scales. Using European confirmed cases and diagnostic test data on COVID-19, the Authors also provided an extensive comparison among European countries and between Europe and Italy at regional scale, for both the two big waves of infection.

Accurately simulating and operating photovoltaic (PV) modules or solar cells requires determining specific model parameters based on experimental data. Extracting these parameters is crucial for analysing system performance under various conditions such as temperature and sunlight variations. However, modelling solar photovoltaic systems is inherently nonlinear, which calls for an efficient algorithm. In [5], Authors employ the MRFO-dFDB (Manta Ray Foraging Optimization with dynamic Fitness Distance Balance) algorithm, which utilises fitness distance balance to balance the exploration and exploitation of the search area when assessing parameters in solar PV models. By applying MRFO-dFDB to extract parameters from the STP6-120/36 and Photowatt-PWP201 solar modules,

Authors observe exceptional predictive performance for both single diode (SDM) and double diode (DDM) models.

Optical Coherence Tomography (OCT) is a smooth application of low coherence interferometer with high air resolution and highly sensitive heterodyne detection technology to tomographic image measurement of living organisms. Currently, clinical applications are becoming more widespread in ophthalmology, cardiovascular system, dermatology, and dentistry. The problem with OCT is that the measurement area is as narrow as a few millimetres compared to other tomographic image measurement techniques, and it was initially applied to ophthalmology. Since then, various researches and developments have been carried out to expand clinical applications. Michelson-type fiber optic interferometer is used for image acquisition. In [6], Authors present a classification of ophthalmic diseases caused by diabetes. Bilateral filter is used for image pre-processing and noise removal. A transfer learning approach is implemented which uses AlexNet and Support vector machine (SVM) to classify the images. The AlexNet model is used to extract the features from the images and these features are then classified using SVM model. The novelty of the proposed model lies in the use of image denoising using bilateral filter and then classification of the AlexNet features using SVM thereby achieving better classification accuracy with less training data. The ailments under study are Choroidal Neovascularization (CNV), Diabetic Macular Edema (DME), DRUSEN, and NORMAL. The approach proposed in [6] produced a higher classification accuracy of 99 % when compared to other deep learning algorithms like CNN, AlexNet and GoogleNet.

Personal comfort modelling is considered the most promising solution for indoor thermal comfort management in buildings. The use of wearable sensors is investigated in [7] for the real-time measurement of physiological signals to train comfort models for buildings monitoring and control. To achieve the required reliability, different uncertainty sources should be considered and weighted in the measurement results evaluation. The study presented in [7] is an example of personal comfort model (PCM) development based on wearable sensors (i.e., Empatica E4 smartband and MUSE headband) acquiring multimodal signals (i.e., photoplethysmographic – PPG, electrodermal activity – EDA, skin temperature – SKT, and electroencephalographic – EEG ones), together with a metrological characterisation of the modelling procedure. Starting from the data collected within an experimental campaign on 76 subjects, different Machine Learning (ML) algorithms were exploited to create comfort models capable of predicting the human thermal sensation (TS). The most accurate model was considered to investigate the impact of sensors uncertainty through a Monte Carlo simulation. Results showed that the Random Forest model is the best-performing one (accuracy: 0.86). The Monte Carlo simulation method proved that the model is very robust towards measurement uncertainties of input features (expanded uncertainty of the model accuracy: $\pm$ 0.04, k = 2). This confirms the possibility of deriving the subject's TS exploiting only physiological signals; measurement uncertainty is influenced mostly by PPG and EDA signals. This kind of investigation could lead to the development of PCMs, exploitable within control systems to optimize subjects' well-being and build energy efficiency

Also this issue includes papers dealing with different topics but linked by the common denominator of measurements. I hope you will enjoy your reading.

Francesco Lamonaca
Editor in Chief

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