ACTA IMEKO
ISSN: 2221-870X
September 2024, Volume 13, Number 3, 1 - 3

Introductory notes for the Acta IMEKO third issue in 2024

Francesco Lamonaca[1,2]

[1] *Department of Department of Computer Science, Modeling, Electronics and Systems Engineering (DIMES), University of Calabria, Ponte P. Bucci, 87036, Arcavacata di Rende, Italy*
[2] *National Research Council of Italy, Institute of Nanotechnology (CNR-NANOTEC), Rende, Italy*

Section: EDITORIAL

Citation: F. Lamonaca, Introductory notes for the Acta IMEKO third issue in 2024, Acta IMEKO, vol. 13 (2024) no. 3, pp. 1-3. DOI: 10.21014/actaimeko.v13i3.1940

Received September 29, 2024; **In final form** September 29, 2024; **Published** September 2024

Corresponding author: Francesco Lamonaca, e-mail: editorinchief.actaimeko@hunmeko.org

Dear Readers,

It is my pleasure to announce that Acta IMEKO is now indexed in Web of Science, Scopus, and DOAJ.

Articles published after 2022, beginning with vol. 11 issue 1, will be included in the Emerging Sources Citation Index of Web of Science. As EiC of Acta IMEKO, is my duty to thank all the Editorial Board members, the Reviewers and the Readers for making all this possible.

As usual, this issue includes papers that do not belong to a specific special issue or thematic section, and it is my pleasure to give to you an overview of them.

The research presented in [1] aims to propose a new approach based on the standards for educational and psychological testing validity framework to investigate the existence of generic problem-solving competence across various fields, leading to increased attention in this area. According to the Authors, most of the previous and current approaches are limited in terms of validity and reliability. The investigation proposed in [1] leads to the review of the conceptions of construct validity in educational measurement. The paper focuses on the proposed validity exploration (VE) model, representing an elaborate enterprise and a serial, progressive procedure aligned with the content and structural validity aspects of The Standards framework. The PISA Computer-based Assessment was used as secondary data for this investigation.

The integration of Digital Technologies and Artificial Intelligence (DT&AI) in veterinary practice is one of the key topics to improve Herd Health Management (HHM). The HHM includes the prevention of diseases, the assessment of the welfare, and the sustainability production of farm animals. In dairy cattle farming, particular attention is paid to automatic cow detection and tracking, as such information is closely related to animal welfare and thus to possible health issues. Cows are highly social animals; therefore, a better comprehension of social context can help to improve their management and welfare. In the field of Precision Livestock Farming, computer vision represents a suitable and non-invasive method for automatic cow detection and tracking. In the study proposed in [2], Authors developed and tested the reliability of a deep learning-based computer vision system for the automatic recognition of dairy cows in a barn equipped with Automatic Milking System. The aim is to build the social network of 240 dairy cows (primiparous and multiparous) to understand how social interactions can influence their welfare and productivity.

Lameness is a clinical condition that heavily affects racehorses. As a result, their competitive performance is dramatically deteriorated and side effects such as changes in feeding patterns may manifest. In [3], Authors have presented a developed portable Internet of Things (IoT) infrared imaging device, whose application is aimed towards on-site farm level detection of lameness in equine. Additionally, an in-debt review of the causes of lameness is presented, together with the underlying biological changes that it induces, its influence over tissue thermal patterns and how exercise affects a racehorse's temperature profile.

The recourse to Quantum Mechanics for the definition of the International System of Units has been the trigger of significant progress. In the first part of [4], the Author briefly recalls the definitions of units now in use for the basic quantities. He summarizes the levels of precision available today within the framework of these definitions. Time is a very special physical quantity and, in the second part of the paper, the Author exposes the extended use that could be made of the expression of physical quantities by means of time, like what is already practiced for the masses, expressed by means of energies. The Author details a little more the case of the electrical quantities voltage and resistance which, without being basic quantities, benefit from new approaches thanks to two quantum phenomena: the Josephson effect, and the Quantum Hall Effect. But time is not an absolute. the paper exposes also the corresponding teachings brought by Special Relativity on the one

hand, and General Relativity on the other hand. Finally, the perspectives of the field are presented under the aspect of the metrological repercussions. Indeed, the technologies applicable to the measurement of time lead to performances that can be considered extraordinary in absolute terms, and in any case superior in relative terms to anything that can be achieved for other physical quantities.

Bearings are the most common components employed in machine parts. The bearings' movement facilitates the smooth motion. They also help with friction reduction. The faults in bearings are often caused by tribological parameters. Various methods have been developed to identify faults in bearings, but they often fail to predict them accurately. The research presented in [5] has concentrated on designing an effective fault-recognizing model. Therefore, a framework, the Zebra-based Radial Basis Prediction Mechanism (ZbRBPM), was proposed. Initially, the bearing datasets are collected, and mineral oil (MO) lubrication is added to minimize wear and friction. The primary goal of the work in [5] is to detect and classify the fault in the thrust ball bearing. The bearing vibration data included a normal vibration signal, a ball fault, and inner and outer race faults. Hence, Zebra fitness is enhanced for the optimization of tribological parameters and fault identification. The proposed model is executed in the MATLAB system. Finally, performance criteria like accuracy, precision, recall, F-score, error rate, computation time, speed, specific wear rate, friction torque, and energy consumption are computed. The performance of the proposed ZbRBPM gains better accuracy rate as 99.5 %, 99 % of precision and f-score and 99.4 % of recall. Also it significantly reduced the prediction error rate to 0.5 % with lower computation time and very low wear and friction.

In [6], the authors propose a bearing fault detection method using second-order moment spectrum and adaptive time-varying morphological filtering. The second-order moment spectrum is a method designed to simplify the complex shape of the spectrum, thus facilitating its interpretation for the identification and localization of defects based on peak frequency. Generally used as a final step in defect detection methods, this method offers the advantage of a more easily interpretable spectral shape. Compared to the shape of the spectrum of the vibration signal defined by the Fourier transform, which includes sidebands composed of peaks of large amplitude at different frequencies, the spectrum generated by the second-order moment spectrum method stands out for its simplicity. Starting from the mean and standard deviation of the vibration signal, the second-order moment can be defined as the power of the ratio between the standard deviation and the difference between the signal and the mean. Next, the Fourier transform is applied to express the second-order moment spectrum. The performance of the second-order moment spectrum is evaluated using the principle of comparison with the envelope spectrum obtained by the Hilbert transform. Vibration signals are analysed using two methods: adaptive time-varying morphological filtering and second-order moment spectrum. After applying these methods to the signals from the database, Authors observe high-amplitude peaks at the frequencies corresponding to inner ring and ball defects. The second-order moment spectrum gives similar results to those obtained with the Hilbert transform envelope.

Structural Health Monitoring (SHM) and early warning systems (EWSs) play a pivotal role in enhancing seismic resilience for both buildings and occupants. The paper in [7] introduces a monitoring platform that collects electrical impedance data from scaled concrete beams undergoing load and accelerated degradation tests. Artificial Intelligence (AI) algorithms are employed for predictive analysis, scrutinizing historical impedance data, and forecasting future trends. These algorithms adapt to environmental parameters, becoming valuable tools in data-driven decision-making processes. In particular, the study investigates concrete specimens in different test conditions, utilizing a distributed sensor network based on electrical impedance as well as temperature and relative humidity sensors. Real-time data are transmitted to a cloud infrastructure during accelerated degradation tests (both in water and in chloride-rich solution), and in room conditions. An AI-based forecasting approach using Prophet is proposed, having as input electrical impedance and temperature data, and tested to predict electrical impedance corresponding to approximately 10 % of the time series balancing responsiveness with predictive accuracy, crucial for effective EWS operations and management requirements. The performance of the tested models is assessed employing metrics such as Mean Average Error (MAE), Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), and correlation. The proposed approach surpasses statistical methods and deep learning techniques, reporting a MAPE always lower than 3.20 % and a correlation higher than 81.65 % (in wet-dry cycles in water these values are 0.65 Ω and 91.85 %, respectively). This proves to be a promising step towards transparent SHM, which integrates AI models facilitating self-monitoring and early maintenance prediction, thus enhancing the resilience of the built environment.

The paper in [8] proposes a systematic approach for the optimization of scan parameters for industrial X-ray computed tomography (XCT), as regard its specific application as diagnostic tool on carbon fiber-reinforced polymer materials (CFRP). This procedure allows the system operator to overcome suboptimal scan results due to a subjective choice of XCT parameters. In [8], XCT scan quality has been measured in terms of contrast-to-noise ratio (CNR) metric, by calculating it on collected XCT 2D projection images. A four-factor five-level central composite design (CCD) was implemented to perform experiments, and a quadratic polynomial model was chosen to describe the effects of XCT scanning parameters combination on CNR measurement and finally to predict optimal results. Analysis of variance was carried out to evaluate the significance of the model on the response, reporting a R2 of 97.1 %, and response surface analyses were also performed for CNR optimization purposes. In order to validate the CCD results, different XCT parameters combinations, coming from the CCD analysis on projection images, were used to run different scans, and, as result, the optimal CNR predicted from the model was also reflected in an optimal CNR measured on the reconstructed XCT images.

Also this issue contains paper presenting scientific research in line with the UN-Goals [9]. In particular [1] deals with UN-Goal 4 (quality education), [2] and [3] deal with UN-Goal 2 (Zero Hunger), [5] and [6] with UN-Goal 9 (Industry, Innovation and Infrastructure), [7] and [8] with UN-Goal 11 (Sustainable Cities and Communities).

I hope you will enjoy your reading.

Francesco Lamonaca
Editor in Chief

REFERENCES

[1] L. A. Nguyen, M. Courtney, M. Wilson, C. T. K., A validity exploration model related to the existence of the generic problem-solving competence , Acta IMEKO 13 (2024) 3, pp. 1-7.
DOI: 10.21014/actaimeko.v13i3.1338

[2] L. Ozella, A. Magliola, S. Vernengo, M. Ghigo, F. Bartoli, M. Grangetto, C. Forte, G. Montrucchio, M. Giacobini, A computer vision approach for the automatic detection of social interactions of dairy cows in automatic milking systems, Acta IMEKO 13 (2024) 3, pp. 1-6.
DOI: 10.21014/actaimeko.v13i3.1628

[3] S. Rizanov, P. Yakimov, Internet of things infrared imaging device for assessing lameness in racehorses, Acta IMEKO 13 (2024) 3, pp. 1-6.
DOI: 10.21014/actaimeko.v13i3.1635

[4] J. Fanton, Time and Metrology, Acta IMEKO 13 (2024) 3, pp. 1-10.
DOI: 10.21014/actaimeko.v13i3.1695

[5] S. Mary Evanchalin, T. Milton, F. M. Tamil, A. Chaudhari, A. Mogra, Thrust ball bearing fault identification from visualized data using optimized deep network, Acta IMEKO 13 (2024) 3, pp. 1-11.
DOI: 10.21014/actaimeko.v13i3.1839

[6] K. Bouaouiche, Y. Menasria, D. Khalfa, S. Teyar, H. Gheribi, Bearing fault detection using second-order moment spectrum and adaptive time-varying morphological filtering, Acta IMEKO 13 (2024) 3, pp. 1-8.
DOI: 10.21014/actaimeko.v13i3.1707

[7] A. Mancini, G. Cosoli, A. Mobili, L. Violini, G. Pandarese, A. Galdelli, G. Narang, E. Blasi, F. Tittarelli, G. Marco Revel, A monitoring platform based on electrical impedance and AI techniques to enhance the resilience of the built environment, Acta IMEKO 13 (2024) 3, pp. 1-12.
DOI: 10.21014/actaimeko.v13i3.1722

[8] S. Casaccia, G. Pandarese, V. Castorani, G. Marco Revel, Design of an experimental approach based on the contrast-to-noise ratio measurement for X-ray computed tomography parameters optimization applied to a carbon fiber-reinforced polymer materials scan, Acta IMEKO 13 (2024) 3, pp. 1-8.
DOI: 10.21014/actaimeko.v13i3.1789

[9] United Nations - Department of Economic and Social Affairs - Sustainable Development, THE 17 GOALS. Online [Accessed 29 September 2024]
https://sdgs.un.org/goals