

Introductory notes for the Acta IMEKO Special Issue on the XXX Italian National Congress on Mechanical and Thermal Measurements

Alfredo Cigada¹, Roberto Montanini², Andrea Scorza³

¹ Dipartimento di Meccanica, Politecnico di Milano, Via La Masa 1- 20156 Milano, Italy

² Dipartimento di Ingegneria, Università degli Studi di Messina, C.da di Dio - 98166 Villaggio Sant' Agata, Messina, Italy

³ Dipartimento di Ingegneria Industriale Eletttronica e Meccanica, Università degli Studi Roma Tre, via Vito Volterra 62 - 00146 Roma, Italy

Section: EDITORIAL

Citation: Alfredo Cigada, Roberto Montanini, Andrea Scorza, Introductory notes for the Acta IMEKO Special Issue on the XXX Italian National Congress on Mechanical and Thermal Measurements, Acta IMEKO, vol. 12, no. 2, article 3, June 2023, identifier: IMEKO-ACTA-12 (2023)-02-03

Received June 28, 2023; **In final form** June 30, 2023; **Published** June 2023

Copyright: This is an open-access article distributed under the terms of the Creative Commons Attribution 3.0 License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

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

Dear Readers,

The scientific knowledge and technological progress are based on the evaluation of physical quantities, therefore it should be not surprising that research activities focused on measurement methods and systems, as well as the culture of measurements, are matter of actual interest and consideration for the scientific and technical community.

In particular, among the most significant research topics, Mechanical and Thermal Measurements must be considered a science on its own and list a very wide range of applications concerning mechanical and thermal quantities: from the design and development of sensors to the characterization of measurement methods and systems, from processing of the measurement signal to the management and quality assessment of the measurement data, from sensor networks to applications in mechanical and thermal systems, materials and data science, automation and home automation, IoT, transport, environment and cultural heritage, avionics, instrumentation for diagnosis and healthcare, safety, space instrumentation.

The heterogeneity and specificity of all the abovementioned aspects find a lively and fruitful field of comparison and discussion in the yearly Italian meeting of “Forum Nazionale delle Misure” where new ideas and trends in the measurement science and technology are proposed together with the colleagues manly dealing with the Electric and Electronic Measurements.

In 2022 the Forum was organized as in-person meeting and took place in September 2022 in Brescia, Italy. As usual, some joint meetings between scientists from the Mechanical and Thermal Measurement and the Electrical and Electronic Measurement academic groups have taken up as part of the workshop, providing inspiring discussions and feedback on the shared topics thanks to the different viewpoints and cultural background.

Moreover more specific topics have been covered in separate sessions, where in depth debates within the two groups have been carried out.

This special issue collects a selection of 7 papers presented during the three days of the “Forum”: the authors have been asked to review their work and prepare an extended version, fit for the publication on ACTA IMEKO. The heterogeneity of the topics covered in the selected works is coherent with the transversality and cultural richness of the Mechanical and Thermal Measurements field, providing a lot of food for thought to the reader.

In the paper ‘*Development and verification of self-sensing structures printed in additive manufacturing: a preliminary study*’, A. Quattrocchi and R. Montanini [1] deal with the development of a demonstrative self-sensing structure, which was obtained by embedding a FBG sensor during the 3D stereolithographic (SLA) printing process. They report the strategies developed in order to ensure a correct adhesion of the FBG sensor embedded into the structure and the experimental tests used for validating the structural response of the self-sensing specimen.

The paper ‘*Development and metrological characterization of cement-based elements with self-sensing capabilities for structural health monitoring purposes*’ by G. Cosoli et al. [2] provides the results of the metrological characterization of different types of mortar with self-sensing capabilities, embedding sensing electrodes for electrical impedance measurement, thus proving their piezoresistive ability. The results were compared to standard measurements performed with traditional strain gages.

Alizzio et al. [3] of the research group of the Mediterranean University of Reggio Calabria presented a paper entitled ‘*IOT environmental quality monitoring in smart buildings in presence of measurement uncertainty: a decision making approach*’, dealing with the project and implementation of a smart monitoring system, which acquires and analyses data collected by a network of distributed

sensors and, through the setup and calibration of two decision making algorithms, activates forced ventilation if the level of comfort is below the desired threshold, taking also into account how measurement uncertainty affects the decision taken.

The paper, ‘*Experimental analysis on the exploding wire process for nanopowder production: Influence of initial energy and exploding atmosphere*’ by Caposciutti et al. [4], deals with exploding wire technique in nanoparticles production, exploring the effect of the input energy and the medium in which the explosion takes place on the final dimensional distribution of nanopowders. Utilizing a proper power supply and an exploding system developed on purpose, they apply up to 10 GA/m² to copper wire samples immersed, in air or water, and collect the products for morphological analysis, performing a shape and dimensional characterization, based on a statistical analysis of the obtained particles.

The paper entitled ‘*Extraction of a floor plan from a points cloud: some metrological considerations*’ by D’Emilia et al. [5] addresses the procedure for extracting a floor plan from a points cloud acquired by means of a laser scanner, during the design of evacuation plans for safety purposes in a baroque cathedral. In the work some critical passages have been examined, presenting similar widths but different characteristics i.e., flat and regular geometries of the elements on the walls, in some cases, statues, columns and adornments, in some others.

A completely different field of application concerns the paper ‘*A Principal Component Analysis to detect cancer cell line aggressiveness*’, that reports some very last results obtained by the research group led by Prof. Rizzuto at the University of Roma La Sapienza [6]. The paper aims at providing the use of Principal Component Analysis (PCA) as a new post-processing method for the detection of breast and bone cancer cell lines cultured in vitro using a microwave biosensor. The results showed that the four analyzed cancer cell lines exhibited peculiar dielectric properties when compared to each other and to the growth medium, confirming that PCA could be employed as an alternative methodology to analyze microwave characterization of cancer cell lines.

In the end, the paper ‘*Sample volume length and registration accuracy assessment in quality controls of PW Doppler diagnostic systems: a comparative study*’, written by the research unit of the University of Roma Tre, led by Prof. Sciuto [7], deals with the performance assessment of clinical Doppler Ultrasounds, focusing on a comparative investigation based on a novel test parameter for the automatic analysis of faults in sample volume length and range gate registration accuracy in Pulsed Wave (PW) systems. The test parameter was assessed through an automatic method that post-processes PW spectrogram images acquired at six sample volume depths with respect to the vessel radius. Tests were repeated for three brand-new ultrasound diagnostic systems, equipped with convex and phased array probes, in two different working conditions.

In the paper ‘*Monte Carlo human identification refinement using joints uncertainty*’, M. De Cecco, A. Luchetti, and M. Tavernini [8] present a new method to re-identify the same individual among different people using RGB-D data. The process extracts a colour-based descriptor and a local feature descriptor through a Monte Carlo-based algorithm taking into account the uncertainty

of human joints and, applied to each descriptor, refines the similarity match against a spatiotemporal database that updates over time. The robustness of the method makes it suitable also for industrial applications.

We gratefully acknowledge all the Authors who have contributed to this special issue, as well as all the Reviewers. A special thanks goes to Prof. Francesco Lamonaca, Editor in Chief of Acta IMEKO, for his enthusiastic and precious help that supported this special issue.

We are flattered to have helped our national research group in its growth thanks to this special issue and we look forward to a wider and qualified participation in the next editions of our Forum.

Alfredo Cigada, Roberto Montanini and Andrea Scorza,
Guest Editors

REFERENCES

- [1] Antonino Quattrocchi, Roberto Montanini, Development and verification of self-sensing structures printed in additive manufacturing: a preliminary study, Acta IMEKO, vol. 12, No. 2, 2023, pp.1-7.
DOI: [10.21014/acta_imeko.v12i2.1431](https://doi.org/10.21014/acta_imeko.v12i2.1431)
- [2] Gloria Cosoli, Alessandra Mobili, Elisa Blasi, Francesca Tittarelli, Milena Martarelli, Gian Marco Revel, Development and metrological characterization of cement-based elements with self-sensing capabilities for structural health monitoring purposes, Acta IMEKO, vol. 12, No. 2, 2023, pp.1-12.
DOI: [10.21014/acta_imeko.v12i2.1420](https://doi.org/10.21014/acta_imeko.v12i2.1420)
- [3] Damiano Alizzio, Claudio De Capua, Gaetano Fulco, Mariacarla Lugarà, Valentina Palco, Filippo Ruffa, IOT environmental quality monitoring in smart buildings in presence of measurement uncertainty: a decision making approach, Acta IMEKO, vol. 12, No. 2, 2023, pp.1-8.
DOI: [10.21014/acta_imeko.v12i2.1421](https://doi.org/10.21014/acta_imeko.v12i2.1421)
- [4] Gianluca Caposciutti, Bernardo Tellini, Paola Saccomandi, Alfredo Cigada, Experimental analysis on the exploding wire process for nanopowder production: Influence of initial energy and exploding atmosphere, Acta IMEKO, vol. 12, No. 2, 2023, pp.1-9.
DOI: [10.21014/acta_imeko.v12i2.1426](https://doi.org/10.21014/acta_imeko.v12i2.1426)
- [5] Giulio D’Emilia, Luciano Chiominto, Antonella Gaspari, Stefano Marsella, Marcello Marzoli, Emanuela Natale, Extraction of a floor plan from a points cloud: some metrological considerations, Acta IMEKO, vol. 12, No. 2, 2023, pp.1-9.
DOI: [10.21014/acta_imeko.v12i2.1427](https://doi.org/10.21014/acta_imeko.v12i2.1427)
- [6] Livio D’Alvia, Serena Carraro, Barbara Peruzzi, Enrica Urciuoli, Ludovica Apa, Emanuele Rizzuto, A Principal Component Analysis to detect cancer cell line aggressiveness, Acta IMEKO, vol. 12, No. 2, 2023, pp.1-7.
DOI: [10.21014/acta_imeko.v12i2.1136](https://doi.org/10.21014/acta_imeko.v12i2.1136)
- [7] Giorgia Fiori, Gabriele Bocchetta, Silvia Conforto, Salvatore A. Sciuto, Andrea Scorza, Sample volume length and registration accuracy assessment in quality controls of PW Doppler diagnostic systems: a comparative study, Acta IMEKO, vol. 12, No. 2, 2023, pp.1-6.
DOI: [10.21014/acta_imeko.v12i2.1425](https://doi.org/10.21014/acta_imeko.v12i2.1425)
- [8] Mariolino De Cecco, Alessandro Luchetti, Mattia Tavernini, Monte Carlo human identification refinement using joints uncertainty, Acta IMEKO, vol. 12, No. 2, 2023, pp.1-11.
DOI: [10.21014/acta_imeko.v12i2.1423](https://doi.org/10.21014/acta_imeko.v12i2.1423)