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Introduction to the Acta IMEKO Thematic Issue on “Shaping the Future of Photonic Metrology”

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Dear Readers,

This Thematic Issue, titled “Shaping the Future of Photonic Metrology”, is the result of work of the Technical Committee 2 'Photonics' within the IMEKO framework. The papers were presented at the PhotoMet 2025 Conference on Modern Photonic Metrology, held in Modena, Italy, from September 1 to 3, 2025. Here, you will find excellent and engaging expanded versions of selected papers from PhotoMet 2025. All contributions examine the field of photonics from various perspectives and application areas.

The first paper, by Vieira de Oliveira et al. [1], addresses optical metrology on metallic surfaces, specifically focusing on the non-destructive measurement of coatings. This challenging task was accomplished using shearography techniques. Improved and continuously evolving image processing and acquisition technologies are opening new possibilities in this area. Furthermore, the use of additive manufacturing in sensor design has resulted in a compact, lightweight system. Overall, the authors present a powerful tool that will contribute to improving industrial inspection processes.

Thanks to significantly enhanced accuracy, 3D printing is becoming increasingly important in industrial manufacturing. Consequently, there has been extensive research into how this technology can be utilized for optical assemblies. A crucial factor in the use of such printed parts is the application of a suitable reflective surface coating. In this context, Gibertoni and Rovati investigated highly reflective coatings for 3D-printed optical components [2]. Their paper describes the study of two different coatings applied to 3D-printed optical elements, as well as the results achieved with the substrates used. These findings offer great potential for the future, particularly as the production of entire optical systems via 3D printing becomes a reality.

Optical 3D measurement techniques are of great importance for a wide range of industrial applications. Consequently, numerous system configurations and computational methods have been established. However, for the specific field of underwater inspection, Regner et al. [3] present an innovative stereovision-based approach to 3D reconstruction that combines inverse triangulation with spatiotemporal correlation algorithms. The proposed method achieves a low measurement error, which is likely to lead to greater acceptance of the system in industrial underwater applications in the future.

An extremely interesting study was presented by Gallerani et al. in [4], involving the use of optical measurement technology in the field of biomedical sensors. This article introduces a novel, low-cost, disposable fluorescence-based pCO_2 sensor that enables intelligent blood gas analysis. The authors demonstrate that the wavelength range near the UV spectrum yields excellent results compared to current sensor approaches. The developed sensor head is characterized by a high level of integration and opens up new possibilities for blood gas measurement.

Advanced Driver Assistance Systems (ADAS) are a key factor in enhancing road safety. In modern vehicles, numerous sensors employ optical technologies to gather data for driver assistance or to supply sensor information to automatic control systems. Environmental conditions pose a significant challenge for this type of sensor. The paper by Cassanelli et al. [5] investigates the Meteorological Optical Range (MOR) of such sensor systems in foggy conditions. The authors developed both a simulation model and an experimental setup to validate their approach. Additionally, an image contrast method was used to characterize specific conditions relevant to ADAS. The study's results and insights provide a better understanding of the relationship between fog and various sensor configurations and are expected to contribute to the development of new functions for future ADAS sensors.

The calibration of optical sensors is a well-known topic in optical meteorology. In paper [6], Besozzi et al. address this subject within the context of photometric and radiometric measurements. Since the authors utilize cost-effective multi-channel (multispectral) sensors, the method is ideally suited for reducing system costs—provided the sensors' spectral sensitivity meets the quality criteria required for the specific application. As

part of the experiments, three different types of multispectral sensors were characterized using a spectrometer and known radiation sources. The reconstruction of radiation spectra highlights the significant potential of these sensors for industrial applications.

This Thematic Issue offers a comprehensive overview of the diverse facets of photonics and their potential applications.

Enjoy your reading!

Maik Rosenberger
Section Editor

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