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Optical Measurements

Optical sensing techniques are used in a large variety of application fields where fast, portable, remote-sensing, low-cost and/or rugged devices are required for detection, identification, and measurements of a variety of parameters. Sensors based on optical fibers are exploited in demanding applications, including pharmaceutical research, medical diagnostics, environmental monitoring, structural health monitoring, physical parameters detection, industrial applications, food safety and security. In these instances, sensors systems often benefit from the versatility of glass, plastic or specialty optical fibers.

In a similar way, optical measurements can also be based on planar waveguides to realize integrated optical sensors or biosensor systems (lab-on-chip). Extremely compact label-free optical bio-chemical sensors can be explored for "Smart Cities" applications, as in water or air quality monitoring, through an IoT (Internet of Thing) approach, or, alternatively, they can be used on board of simple robots, based on an autonomous operation, to map the concentrations of pollutants in several scenarios.

In recent years, new measurement schemes, materials, and devices, based on distributed and point sensing, have been presented to improve the performances, the miniaturization, the multiplexing capabilities, and the microfluidic integration of optical sensors in several applications.

The main purpose of this special issue of *Instrumentation & Measurement Magazine* is to give readers a glimpse of this exciting field by bringing together researchers active in the innovative developments of transducer schemes, smart materials, nanostructures, and applications of optical sensor systems, providing an overview on most recent advances.

Eleven representative papers are presented, introducing original optical sensor-based solutions for interesting applications and showing novel sensing approaches that are based mainly in optical fibers.

The paper "Linearity and Nonlinearity in Hollow-Core Antiresonant Fiber Sensors in the Terahertz Regime" by Jakeya Sultana *et al*. presents an interesting analysis on hollow-core antiresonant fiber sensors.

In the work "Precisely Designed and Modeled Double-Clad Fiber Optic Pressure Sensor," Mohammad Davoud Talebzadeh and Marzieh Khademalrasool propose a new pressure sensor configuration based on specialty optical fibers.

A very interesting non-contact sensor to measure the liquid level, exploring the synergy between optical interferometry and neural networks, is presented by Juan Manuel Ramírez-Cortés *et al*. in "Non-Contact Liquid Level Measurement Using Optical Interferometry and Neural Networks."

The potential of photonics to improve robotics is explored in "Optical Force/Tactile Sensors for Robotic Applications" by Marco Costanzo and Salvatore Pirozzi, where a simple and low-cost optoelectronics force/tactile sensor is reported.

In "Application of a Fiber Optic Refractometric Sensor to Measure the Concentration of Paracetamol in Crystallization Experiments," Liliana Soares *et al*. demonstrate the potential impact that very simple and compact refractometric measurements, enabled by optical fibers, can have in pharmaceutical applications.

An interesting perspective in health applications based on optical fiber sensors is also explored by Arnaldo Leal-Junior and Carlos Marques in "Optical Fiber-Integrated Smart Structures: Towards Transparent Devices for Healthcare 4.0."

In addition, in "Chemical and Biological Applications Based on Plasmonic Optical Fiber Sensors," Chiara Perri *et al*. report bio-chemical sensing applications based on plasmonic sensors supported by optical fibers that can also enable a diversity of new health and environmental applications.

In "Spectral Reconstruction and Bayesian Model Framework for Characterization of Long Period Fiber Gratings," Bernardo Dias *et al*. show us the importance of signal processing in improving the performance of optical sensors in a study on sensors based on Long Period Fiber Gratings.

In a more fundamental approach, the paper "Multi-Plasmonic Resonance Based Sensor for the Characterization of Optical Dispersion Using a D-Shaped Photonic Crystal Fiber" by Markos P. Cardoso *et al*. reports an analysis of plasmonic sensors realized in specialty optical fibers.

In "Demonstration of Single Photon Detection in Amorphous Molybdenum Silicide / Aluminium Superconducting Nanostrip," Daniela Salvoni *et al*. present a novel sensor concept/approach to realize single photon detection,

an achievement that can impact the emerging field of quantum sensing.

Finally, in "Design of an FBG Based Water Leakage Monitoring System, Case of Study: An FBG Pressure Sensor," Vincenzo Marletta presents an optical fiber multi-sensor measurement system based on FBG sensors, focused on a measurement system developed to measure the main quantities (pressure, flow rate, and vibrations) useful for the detection of water leakages.

Overall, we hope that the set of works presented in this special issue will give the reader an insight on the diversity, capabilities, and potential of this vibrant field of optical measurements.