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Editorial

Editorial on Special Issue "Modern Applications in Optics and Photonics: From Sensing and Analytics to Communication"

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Optics and photonics are among the key technologies of the 21st century and offer the potential for novel applications in areas as diverse as sensing and spectroscopy, analytics, monitoring, biomedical imaging and diagnostics, as well as optical communication technology, among others. The high degree of control over optical fields that is possible today, for example, by using micro- and nano-optics together with the tremendous capabilities of modern processing and integration technology, enables new optical measurement systems with enhanced functionality and unprecedented sensitivity. Such systems are thus attractive for a wide range of applications that have been previously inaccessible and may ultimately lead to the democratization of optics and photonics. This Special Issue aims to provide an overview on some of the most advanced application areas in optics and photonics and indicate the broad potential for the future. The Special Issue contains 15 papers which all underwent substantial peer-review under the guidelines of the MDPI *Applied Sciences* journal. The fifteen papers are divided into five categories: Fiber Optic Sensing, Optical Communication, Distributed Sensing, Optical Imaging and Laser Technology.

1. Fiber Optical Sensing

In the area of fiber optic sensing, five papers are presented in this Special Issue. For example, Bremer et al. [1] reported an investigation on the feasibility of utilizing Mode Division Multiplexing (MDM) for simultaneous measurement of Surrounding Refractive Index (SRI) and temperature using a single sensor element based on an etched OM4 Graded Index Multi Mode Fiber (GI-MMF) with an integrated fiber Bragg Grating (BG). In another research article by Bremer et al. [2], the durability of functionalized carbon structures (FCS) that are equipped with fiber optic sensors in a highly alkaline concrete environment are investigated. In their investigation, the suitability of optical fibers with different coatings as well as different integration techniques for the FCS were analyzed. In terms of fiber optic strain sensing, a new concept is presented by Mądry et al. [3], where, an intensity-modulated Sagnac loop sensor based on Polarization-Maintaining Photonic Crystal Fiber (PM-PCF) in a setup with a Dense Wavelength Division Multiplexer (DWDM) for strain measurement, is presented. The proposed setup uses an optical power measurement scheme, i.e., as opposed to measurement of wavelength, and thus would be relatively cheaper when compared to the utilization of complex optical spectrum analyzers for the target application. Moreover, two additional research papers presented by Xie et al. [4] and Xue et al. [5] have also been categorized under the rubric "fiber optic sensing". For instance, Xie et al. [4] reported the application of an integrated optical electric-field sensor on the measurements of transient voltages in AC high-voltage power grids. They developed an integrated optical electric-field sensor based on the Pockels effect to measure the transient voltages of high-voltage conductors and achieved a response speed faster than 6 ns and a wide bandwidth ranging from 5 Hz to 100 MHz [4]. In contrast, Xue et al. [5] present an electro-optic dual-comb Doppler velocimeter for high-accuracy velocity measurement by generating two optical combs using electro-optic phase modulators and tracing their repetition frequencies to a rubidium clock and demonstrating experimentally a high accuracy in the range of 100–300 mm/s with a maximum deviation of 0.44 mm/s.

2. Optical Communications

The category of optical communications is represented by a research article from Kirrbach et al. [6] and a review article from Lallas [7]. The research article from Kirrbach et al. [6] investigates the use of Optical Wireless Communications (OWC) for on-axis rotary communication scenarios by discussing different realization approaches for bi-directional full-duplex links as well as designing a monolithic hybrid transmitter–receiver lens and studying its performance using ray trancing simulations. The article by Lallas [7] reviews current and future state-of-the-art plasmonic system implementations for THz communications.

3. Distributed Sensing

In terms of distributed sensing, one paper is presented by Wiesmeyr et al. [8]. In their research article, the real-time train tracking from distributed acoustic sensing data is reported by presenting an algorithm that extracts the positions of moving trains for a given point in time from Distributed Acoustic Sensing (DAS) signals.

4. Optical Imaging

In the area of optical imaging, five papers are included in this Special Issue. For example, Kerrouche et al. [9] report the development of rapid and low-cost pathogen detection systems using microfluidic technology and optical image processing by employing a cost-effective microscopic camera and computational algorithms and detecting small size microbeads (1–5 µm) from a measured water sample. In contrast, Dong et al. [10] propose a method based on dependence analysis to identify and then eliminate the measurement configurations with redundant information in optical scatterometry for fast nanostructure reconstruction. In terms of Optical Coherence Tomography (OCT), Yi et al. [11] report a mesh-based Monte Carlo model in order to study OCT signals reflecting the structural and functional activities of brain tissue as well as to improve the quantitative accuracy of chromophores in tissue. Furthermore, Wang et al. [12] evaluate the performance of different closed path determination methods in order to measure the topological charge (TC) of an optical vortex (OV) beam and Fricke et al. [13] present a non-contact dermatoscope with ultra-bright light source and liquid lens-based autofocus function. Moreover, Fricke et al. [13] could demonstrate, i.e., with their prototype, feature resolution of up to 30 µm and feature size scaling fulfilling the requirements to apply the device in regular skin cancer screening.

5. Laser Technology

Furthermore, two research papers of this Special Issue can be categorized as relating to laser technology. For instance, Čehovski et al. [14] report on the integration of organic thin-film lasers directly into polymeric single-mode ridge waveguides forming a monolithic laser device and obtaining single-mode characteristics even with high pump energy densities and thus demonstrating its suitability for lab-on-a-chip (LoC) applications. In another research paper by Huang et al. [15], a sub-nanosecond Nd:YVO4 laser system at 1 kHz repetition rate without Stimulated Raman Scattering (SRS) with high peak power and high beam quality is reported with a maximum output energy of 65.4 mJ and a pulse duration of 600 ps which corresponds to a pulse peak power of 109 MW. Huang et al. could also achieve 532 nm green light with an average power of 40.5 W and a power stability of 0.28% by frequency doubling with an LBO crystal.

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