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Editorial

Advanced Infrared Technology and Applications 2015

Guest Editors

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This special issue of *Measurement Science and Technology* focuses on the 13th International Workshop on Advanced Infrared Technology and Applications (AITA), held in Pisa, Italy from September 29 to October 2, 2015. While meeting participants were particularly encouraged to submit their work, the issue has been open to all contributions.

AITA is a biennial workshop organized by Giorgio Ronchi Foundation, in collaboration with the Institute of Information Science and Technologies 'Alessandro Faedo' (ISTI), the Institute of Applied Physics 'Nello Carrara' (IFAC) and the Construction Technologies Institute (ITC) of the National Research Council of Italy (CNR). During the last edition, more than one hundred contributions were received, that resulted into a very rich program consisting in invited and contributed lectures for the 4 days of the workshop. The workshop was held at the Area della Ricerca CNR in Pisa, one of the largest research campus in Italy, and at walking distance from the historical centre of this beautiful Tuscan city.

The main purpose of AITA is to provide an international forum to present and discuss current trends and future directions in infrared (IR) technology, mainly for civilian applications. The workshop also aims at fostering the creation of a permanent network of scientists and practitioners in the field of IR science and technology for an easy and immediate access to people, technologies and ideas. In such a wide area, covering all the spectrum of IR radiation and disparate applications ranging from non-destructive testing to biomedical applications, *measurement* has always represented a key underlying thread.

This special issue was born on the consideration that advances in IR technology cannot be separated from advances in theory and practice of related measurement and instrumentation. Some of the best contributions presented at AITA and focused on these topics were selected and invited for inclusion in this issue. The latter is aimed at scientists, engineers and practitioners interested in understanding the basic principles of measurement in IR science as well as in discovering recent advances in sensing and measurement techniques.

This special issue includes six papers, which cover some novel scientific and technological aspects that are representative of the topics of interest both for the IR and metrology communities.

The paper 'Accuracy improvement in dissipated energy measurement by using phase information' by Shiozawa *et al* [1] presents a technique for improving the accuracy of a dissipated energy measurement based on the phase information—called the phase 2f lock-in IR method. The phase 2f lock-in method utilizes a phase difference between the thermoelastic temperature change and the temperature change due to the energy dissipation and is effective for eliminating the noise component unrelated to the dissipated energy. This method provides an improvement in the accuracy of the fatigue-limit estimation and the detection of future crack initiation points based on the dissipated energy.

The study and measurement of thermomechanical properties of new materials is covered in the paper by Staszczak *et al* [2]. There is indeed an increasing demand for multifunctional smart materials, able to combine the sensing and actuating functions and, thus, enabling innovative applications as well as a reduction of the device mass and size. Among these, shape memory materials like shape memory polymer (SMP) are of great interest. The current study concerning SMP mechanical and thermomechanical properties assures a safe use of SMP elements working in various conditions and contributes to development of some novel applications.

In a similar context, the visualization of the plastic region and the measurement of its size are necessary and indispensable to evaluate the deformation and fracture behavior of a material. In order to evaluate the plastic deformation and fracture behavior in a structural

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member with some flaws, in [3] Ohbuchi, Sakamoto and Nagatomo paid attention to the surface temperature, which is generated by plastic strain energy. The visualization of the plastic deformation has been developed by analysing the relationship between the extension of the plastic deformation range and the surface temperature distribution, which has been obtained by an IR thermo-video system.

The paper by Hellstein and Szwedo [4] instead addresses a novel, real-time 3D temperature mapping method for active thermography analyses. In this paper the method, which relies on the use of ray-tracing GPU rendering algorithms, is applied to the diagnostics of large industrial composite structures, such as boats, planes and wind-turbine blades. Composite materials, in fact, are becoming increasingly popular for the development of large industrial structures, which however may contain several defects due to their non automated preparation. In this context, the proposed method can become a fast and reliable tool to test their quality, able to effectively visualize and localize the defects of the inspected structure.

Besides industrial non destructive testing, IR technologies prove to be useful in a variety of biomedical applications. One example is given by the use of Fourier transform infrared spectroscopy (FTIR) for characterizing novel materials used in medical care. The work by Prejmerean *et al* [5] aims at investigating a series of new light-curing dental resins and their corresponding giomers and to study the polymerization reaction, namely the influence of the resin composition and of the photo-polymerization modes upon the degree of conversion of the dental copolymers and of the corresponding giomers. The determination of conversion degrees in such copolymers and corresponding giomers is achieved by using FTIR and an attenuated total reflection (ATR) technique.

The paper by Blumenstein *et al* [6] is also concerned with biomedical applications. It presents a special sensorized jacket aiming at improving the spatial awareness of patients with cerebral palsy. Accurate characterization of the wearable sensors is provided, together with a method for assessing the trajectory in space followed by the patients taking part in the study, in order to evaluate their skills and improvements in spatial orientation.

It has been an honour for us to be the guest editors of this special issue. We are very grateful to all the authors for the effort they made in preparing excellent and rigorous contributions, without which this issue could not appear. In addition, we thank all the reviewers that—with their valuable comments—have concurred to the quality of the issue and, of course, the entire Editorial Board of *Measurement Science and Technology* for their continuous and professional support.

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