1-24-2014

Advances in Optics for Biotechnology, Medicine and Surgery

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Biomedical Optics EXPRESS

Advances in optics for biotechnology, medicine and surgery

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Abstract: The guest editors introduce a *Biomedical Optics Express* feature issue that includes contributions from participants at the 2013 conference on Advances in Optics for Biotechnology, Medicine and Surgery XIII.

OCIS codes: (170.0170) Medical optics and biotechnology; (170.0110) Imaging systems.

References and links

1. J. Kwon, C.-Y. Lee, J. Oh, and H. W. Kang, "Computational analysis of endometrial photocoagulation with diffusing optical device," Biomed. Opt. Express **4**(11), 2450–2462 (2013).
2. J. Kim, H. W. Kang, J. Oh, and T. Milner, "Thermoelastic displacement measured by DP-OCT for detecting vulnerable plaques," Biomed. Opt. Express **5**(2), 474–484 (2014).
3. A. J. Moy, P. C. Lo, and B. Choi, "High-resolution visualization of mouse cardiac microvasculature using optical histology," Biomed. Opt. Express **5**(1), 69–77 (2014).
4. J. Qi, J. Li, and W.-C. Shih, "High-speed hyperspectral Raman imaging for label-free compositional microanalysis," Biomed. Opt. Express **4**(11), 2376–2382 (2013).
5. W. R. Lloyd, R. H. Wilson, S. Y. Lee, M. Chandra, B. McKenna, D. Simeone, J. Scheiman, and M.-A. Mycek, "In vivo optical spectroscopy for improved detection of pancreatic adenocarcinoma: a feasibility study," Biomed. Opt. Express **5**(1), 9–15 (2014).
6. G. Zheng, X. Ou, and C. Yang, "0.5 gigapixel microscopy using a flatbed scanner," Biomed. Opt. Express **5**(1), 1–8 (2014).
7. O. Yang and B. Choi, "Accelerated rescaling of single Monte Carlo simulation runs with the Graphics Processing Unit (GPU)," Biomed. Opt. Express **4**(11), 2667–2672 (2013).

This feature issue of *Biomedical Optics Express* represents topics covered at the conference on Advances in Optics for Biotechnology, Medicine and Surgery XIII held in Lake Tahoe, California, June 2-5, 2013, the 13th in a series of biennial meetings organized by Engineering Conferences International. The conference co-chairs were A. Claude Boccara (France), Maryann Fitzmaurice (USA) and James W. Tunnell (USA). The guest editors of this issue were conference co-chairs or session chairs, and the papers published are contributions from authors who participated in the meeting.

The conference included oral presentations and posters on (1) optical therapeutics, (2) clinical imaging and spectroscopy, (3) multimodality imaging, (4) spectroscopic assessment of functional and molecular changes in disease, (5) endoscopic microscopy in the clinic, (6) novel microscopy technologies, (7) emerging optical technologies, (8) commercializing optical technologies, and (9) biophotonics and federal funding. The papers featured in this issue represent a cross–section of the diverse work in biomedical optics presented at the meeting, and demonstrate the continuing progress in the field toward clinical translation.

In its opening session, the conference highlighted the growing importance of optics for therapeutic applications, represented in this issue by the work of Kwon et al, who performed a

#205409 - $15.00 USD Received 23 Jan 2014; published 24 Jan 2014

computational thermal analysis of endometrial photocoagulation therapy for abnormal uterine bleeding performed using a novel balloon-catheter optical diffuser [1].

Another focus of the conference was the wide range of optical imaging modalities in development for both clinical and basic science applications. This is represented in this issue by three papers. Two are on vascular imaging at widely differing length scales, one by Kim et al. on differential phase optical coherence tomography (DP-OCT) imaging for clinical studies of vulnerable atherosclerotic plaque in the coronary arteries [2] and a second by Moy et al. on optical imaging for basic science studies of cardiac microvasculature [3]. Both of these studies made use of exogenous optical imaging agents (monocrystallin iron oxide nanoparticles in the study of Kim et al. and a lipophilic fluorescent dye in the study of Moy et al.), another area of intense investigation in the optics community. The third paper by Qi et al. describes a system for high-speed hyperspectral Raman imaging with integrated active-illumination for label-free compositional microanalysis [4], a technique with potential clinical, basic science and industrial applications.

Although much of the work in optics focuses on imaging, including hyperspectral imaging, the conference also reflected the importance of non-imaging spectroscopy techniques in assessing functional and molecular changes in disease. This is brought to the fore in this issue by the paper of Lloyd et al., which describes an in vivo clinical feasibility study of optical spectroscopy for minimally invasive detection of cancer during endoscopic ultrasound-guided fine-needle aspiration of the pancreas [5]. This study illustrates the potential added value of non-imaging optical spectroscopy (so-called 'point' spectroscopy) for disease diagnosis during conventional clinical imaging studies.

The emergence of novel microscopy techniques continues to be an important part of biomedical optics covered in this conference. In this issue, Zheng et al. describe a new approach to high-resolution, wide field-of-view microscopy imaging employing two off-the-shelf components (a closed-circuit-television lens and a low-cost consumer flatbed scanner) that is a radical departure from the standard light microscopy regime [6]. This new microscopy technique can potentially be applied to whole slide imaging, a disruptive new technology in pathology practice, in a cost-competitive fashion.

The continued importance of analytical models for rapid assessment of tissue optical properties, during optical imaging, microscopy and spectroscopy studies, is also highlighted by the paper of Yang et al. on accelerated rescaling of single Monte Carlo simulation runs using a graphics processing unit (GPU) [7].

Again, the papers in this special issue of *Biomedical Optics Express* demonstrate the great diversity of optical techniques in development and highlight the continuing progress of these optics techniques toward clinical translation.

Acknowledgments

The conference was funded by generous support from the National Institute of Biomedical Imaging and Bioengineering, the National Institute of Neurological Disorders and Stroke, (award number R13EB017094), and the National Science Foundation (award number 1340558). Additional funding was provided by corporate sponsors: Hamamatsu Photonics, Intuitive Surgical and Ocean Optics. It should be noted that the content of this issue is solely the responsibility of the authors and does not necessarily represent the official view of the National Institutes of Health or the National Science Foundation.