Photoacoustics 4 (2016) 81–82

Contents lists available at ScienceDirect

Photoacoustics

journal homepage: www.elsevier.com/locate/pacs

Editorial

Special issue introduction: Photoacoustic microscopy

First proposed in the 1970s for non-destructive testing, the modern reincarnation of photoacoustic microscopy (PAM) has major impact in bio-medicine, spanning a wide range of applications from flow cytometry and cancer research to ophthalmology, neuroimaging and cardiovascular diagnostics. The hybrid nature of PAM combining optical excitation and acoustic detection provides it with a number of key advantages over both optical and acoustic microscopy, including versatile optical absorption contrast and high scalability of imaging depth and spatial resolution. The current special issue encompasses broad aspects of PAM with contributions from the photon plus ultrasound research community on new technical developments, biomedical applications and review of state-of-the-art.

Photoacoustic microscopy (PAM) was first introduced in the 1970s for non-destructive testing of inorganic materials [1,2]. Its modern reincarnation for imaging biological tissues, however, has not been fully explored until 1990s. PAM harnesses both strong optical absorption contrast and much reduced ultrasonic scattering in biological tissue [3,4]. Compared with high resolution ultrasonic microscopy, PAM is much more versatile in offering physiology related information; compared with high resolution optical microscopy, PAM has the advantage in deeper penetration depth and more selections of contrast sources. Over the past two decades, PAM has drew an extremely broad spectrum of researchers with expertise from science and engineering (for example lasers, ultrasonic detectors, contrast agent, optical microscopy, and reconstruction algorithm) to biology and medicine (for example animal models, cardiology, oncology, and ophthalmology). As a result, an incredible growth in scientific publications that are related to PAM and its applications has been observed.

In this special issue, we present papers from diverse disciplines, including new PAM system using novel Raman scattering fiber laser and beam deflection based optical detection of ultrasound, and PAM applications to comprehensive examination of human carotid atheroma and ophthalmology.

Buma et al. [5] developed a laser system that takes advantage of multiple Raman scattering peaks in a graded-index multimode fiber to achieve multispectral PAM of lipid-rich tissues and tissue samples within the near-infrared spectral region. Maswadi et al. [6] reported an all-optical PAM system that relays on deflection a probing optical beam shining through the ultrasound propagation path as a result of refractive index modulation. Several advantages are demonstrated using this all-optics ultrasonic detection method as compared with traditional piezoelectric ultrasonic detection. Seeger et al. [7] developed a multimodal system with added capabilities to conduct second/third harmonic generation and two-photon microscopy besides PAM. The novel system demonstrated clear impact in examining cardiovascular system with more comprehensive insights in the pathophysiology of atheroma formation and destabilization. Finally, a mini review by Liu et al. [8] provides a concise yet comprehensive summary of the state-of-the art in PAM application to ophthalmology. At the end of the review, the authors also suggested future technology development directions of PAM eye imaging.

All papers presented in this special issue have undergone a rigorous peer review process, and we are indebted to the reviewers for their efforts in ensuring that the Photoacoustics' highest standards for quality and integrity were met. We are especially grateful to Dr. Vasilis Ntziachristos (Editor-in-Chief), the publication staff at Elsevier, and the many others who contributed behind the scenes for their hard work and dedication to this feature issue. We hope you find the papers in this special issue as inspiring as we did.

Daniel Razansky, Guest Editor

Hao F. Zhang, Guest Editor

http://dx.doi.org/10.1016/j.pacs.2016.08.001

References

[1] A. Rosencwaig, Photoacoustic microscopy, Am. Lab 11 (1979) 39–49.
[2] J.J. Pouch, R.L. Thomas, Y.H. Wong, J. Schuldies, J. Srinivasan, Scanning photoacoustic microscopy for nondestructive evaluation, J. Opt. Soc. Am. 70 (5) (1980) 562–564.
[3] H.F. Zhang, K. Maslov, G. Stoica, L.H.V. Wang, Functional photoacoustic microscopy for high-resolution and noninvasive in vivo imaging, Nat. Biotechnol. 24 (7) (2006) 848–851.
[4] D. Razansky, M. Distel, C. Vinegoni, R. Ma, N. Perrimon, R.W. Koster, V. Ntziachristos, Multispectral opto-acoustic tomography of deep-seated fluorescent proteins in vivo, Nat. Photonics 3 (7) (2009) 412–417.
[5] T. Buma, J.L. Farland, M.R. Ferrari, Near-infrared multispectral photoacoustic microscopy using a graded-index fiber amplifier, Photoacoustics 4 (2016) 83–90, doi:http://dx.doi.org/10.1016/j.pacs.2016.08.002.
[6] S.M. Maswadi, B.L. Ibey, C.C. Roth, D.A. Tsyboulski, H.T. Beier, R.D. Glickman, A.A. Oraevsky, All-Optical Optoacoustic Microscopy Based on Probe Beam Deflection Technique, Photoacoustics 4 (2016) 91–101, doi:http://dx.doi.org/10.1016/j.pacs.2016.02.001.
[7] M. Seeger, A. Karlas, D. Soliman, J. Pelisek, V. Ntziachristos, Multimodal optoacoustic and multiphoton microscopy of human carotid atheroma, Photoacoustics 4 (2016) 102–111, doi:http://dx.doi.org/10.1016/j.pacs.2016.07.001.
[8] W. Liu, H.F. Zhang, Photoacoustic imaging of the eye: a mini review, Photoacoustics 4 (2016) 112–123, doi:http://dx.doi.org/10.1016/j.pacs.2016.05.001.

Hao F. Zhang*
Department of Biomedical Engineering, Northwestern University, Evanston, IL 60208 USA, USA

Daniel Razansky
Institute for Biological and Medical Imaging (IBMI), Technical University of Munich and Helmholtz Center Munich, 85764 Neuherberg, Germany

* Corresponding author.

Received 1 February 2016
Received in revised form 12 May 2016
Accepted 26 May 2016
Available online 25 August 2016