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Editorial

Introduction to the Special Issue on Advances in Biophotonics and Biomedical Optics

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The 9th Chinese–Russian Workshop on Biophotonics and Biomedical Optics was held online on 28–30 September 2020. The bilateral workshop brought together both Russian and Chinese scientists, engineers, and clinical researchers from a variety of disciplines engaged in applying optical science, photonics, and imaging technologies to problems in biology and medicine. During the workshop, 2 plenary lectures, 35 invited presentations, 5 oral presentations, and 8 internet reports were presented. This special issue selects some papers from the attendees and includes both research and review articles.

The papers from this special issue will provide the readers an update on the latest developments in biophotonics and biomedical optics. This issue includes two reviews, focusing on the application of optical nanoprobes in bacterial infection by Ding *et al.* and the application of tissue optical clearing in diabetes-induced pathological changes by Zhu *et al.* In addition, thirteen original research articles are presented, covering the topics of optical imaging, tissue optical clearing, optical interactions with tissue and cells, optical techniques for clinical application.

Specifically, many advanced optical imaging techniques have been developed in recent years and applied to various biomedical applications. In this issue, Wang *et al.* described a two-photon nonlinear SIM (2P-SIM) technique using a multiple

harmonics scanning pattern that employs a composite structured illumination pattern, which can produce a higher order harmonic pattern based on the fluorescence nonlinear response in a 2P process. Kazachkina *et al.* performed a pilot study of the dynamics of tumor oxygenation determination using phosphorescence lifetime imaging of meso-tetra(sulfopheny1)tetrabenzoporphyrin Pd (II) (TBP), and observed a low oxygen content with increased phosphorescence lifetime of TBP in the tumor. Mylnikov *et al.* used the fluorescence imaging methods to reveal the indicated forms of tumor cell death under the combined effect of flavonoid-containing extract of Gratiola officinalis and cytostatic, and found that the combination with a concentration ratio of the extract and cyclophosphamide of 3:1 has the greatest effectiveness due to stimulation of the cytostatic effect and cytotoxic effect. In addition, for the label-free imaging, Dyachenko *et al.* used laser speckle contrast imaging to monitor acute pancreatitis at ischemia-reperfusion of pancreas in rats. Zou *et al.* applied the OCT to investigate the influence of different sized nanoparticles and thermal coagulation-induced changes in the optical properties of normal, benign, and cancerous human breast tissues. Liu *et al.* presented an adaptive Watershed algorithm to automatically extract foveal avascular zone (FAZ) from retinal optical coherence tomography angiography (OCTA) images. Liang *et al.* revealed the underlying mechanisms of artifacts for thermoacoustic imaging (TAI) by investigating the specific absorption rate (SAR) distribution inside tissue phantoms, and showed its high dependence with the geometries of the imaging targets and the polarizing features of the microwave.

Tissue optical clearing technique has become a powerful tool in deep tissue detection. The underlying mechanisms of optical clearing will help better understanding and application of the clearing protocols. In this issue, Genin *et al.* performed complex study of glycerol effects on rat skin tissue from different aspects involving the optical, weight and geometrical properties, and discussed the possible mechanism under the action of glycerol solutions. Jaafar *et al.* presented an investigation of optical clearing agents' influence on probing depth using porcine skin with confocal Raman microspectroscopy (CRM). In addition, Kozintseva *et al.* studied the time dependence of optical clearing by monitoring the luminescence intensity of the upconverting particles (UCNPs), and demonstrated the possibility to use the UCNPs for studying the dynamics of optical clearing of biological tissues under local compression.

The optical interactions with tissue and cells are hotspots in biomedical photonics. In this issue, Gyulkhandanyan *et al.* determined and tested the most effective meso-substituted cationic pyridylporphyrins and metalloporphyrins with high photoactivity against Gram negative and Gram positive microorganisms. Kapkov *et al.* also used the laser tweezers for quantitative measurement of interaction forces between red blood cells (RBSs) and endothelial cells (ECs) in stationary conditions. They showed that the interaction force raises along with increasing concentration of fibrinogen and dextran in all considered cases of ECs interaction with RBCs.

The photonics plays important roles in not only fundamental researches but also clinical diagnosis. In this issue, Hou *et al.* applied the Muller matrix microscope to distinguish microstructural features between high-grade cervical squamous intraepithelial lesion (HSIL) and cervical squamous cell carcinoma (CSCC), and presented results from 37 clinical patients with analysis regions of cervical squamous epithelium. This work provides an efficient method for digital pathological diagnosis and points out a new way for automatic screening of pathological sections.

This issue provides a broad and frontier view about the recent developments in biophotonics and biomedical optics, hence we strongly recommend this issue.

It should be noted that this special issue is just a part of the Chinese–Russian workshop on Biophotonics and Biomedical Optics 2020. Some of the above papers will be published in the first issue of next year. Finally, we thank all the contributing authors for making this issue possible.