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Complex Dynamics and Fluctuations in Biomedical Photonics V

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Introduction

These proceedings are from the conference on Complex Dynamics and Fluctuations in Biomedical Photonics V, held on January 19 and 21, 2007 at the SPIE Photonics West Conference in San Jose, California. It was a two-day meeting featuring 24 oral and, later, poster presentations from leading international research groups.

The goal of the conference was to gather essentially different groups of leading researchers and students, including biophysicists, medical doctors and physicians, mathematicians, and optical and laser engineers, to facilitate future progress in the development of optical and laser technologies based on complex dynamics and fluctuations approaches in biomedical science and clinical applications. These approaches should be useful for diagnosis and therapy of dangerous diseases such as those of the heart, cancer, vascular, mental illness, and many others that manifest as a breach of the living organism's auto-control systems at the level of molecule, cell, organ, or organism as a whole. We hope that the proceedings of this conference will contribute to the development of interdisciplinary fields in science and in applications such as complex dynamics and structures of living systems, biomedical optics, and laser medicine, and that it will be helpful for scientists, medical doctors, engineers, and students.

The conference was organized into several sessions: Coherent-Domain Methods for Monitoring of Tissue Complex Structure and Dynamics, Biophotonic Imaging and Spectroscopy, Blood and Lymph Flow Complex Dynamics, and Microscopy and Nonlinear Dynamic Processes; with nine invited papers.

During the oral session on Coherent-Domain Methods for Monitoring of Tissue Complex Structure and Dynamics, and the poster session, studies of statistical models for laser speckle flowmetry as well as algorithms for simulation of speckles were presented and discussed. Results on nonlinear diffusivity of analytes in tissues measured in vitro and in vivo using OCT, and analysis of local instabilities of imbibition fronts measured with the use of coherent and non-coherent light, were also presented. Spectral domain PS OCT achieved by single camera detection and the dynamic of labeling by gold spheres, nanorods and silica/gold nanoshells in tissues measured by OCT and backscattering spectroscopy, were described in two posters. High contrast imaging of nonmelanoma skin cancers using confocal microscopic imaging was demonstrated in one of invited papers.

In the session Biophotonic Imaging and Spectroscopy, a multispectral multi-distance method to measure optical properties of non-homogeneous tissues, the development of an integrated computerized scheme for metaphase chromosome image analysis, determination of glucose concentration in tissue-like materials using spatially resolved steady-state diffuse reflectance

spectroscopy, and a computational model of polarized light propagation within birefringent biological tissues were analyzed and discussed.

The Blood and Lymph Flow Complex Dynamics session had presentations on volumetric imaging of microcirculations in the human retina and choroids in vivo by optical micro-angiography, imaging of flow velocity profiles within the complex geometry vessels by Doppler OCT, new prospects for noninvasive blood monitoring based on effect of RBC aggregation, and the combined use of fluorescent and dynamic light scattering imaging for applications in vascular biology.

In the session Microscopy and Nonlinear Dynamic Processes and the corresponding portion of the poster session the following topics were discussed: bifurcation and chaos in the spontaneous firing, tomographic phase microscopy, coherence properties of cell membrane motions, computed optical coherence tomography, wavelet-analysis of multimode dynamics in living systems, optimal sorting of neural spikes with wavelet and filtering techniques, and modeling the nonlinear dynamics of immunity at cancer treatment by interleukin-2 conjugate with gold nanoparticles.

In addition to the above-mentioned topics, the poster session also featured the optical properties of human spinal cord and conversion coefficients for external monoenergetic photon beams in the human model.

The conference chairs would like to thank the members of the technical program committee for their help in organizing the conference. We sincerely appreciate the support of the SPIE and the conference staff. Finally, we would like to thank all of the conference attendees and manuscript authors for their contributions and participation, especially the invited speakers, who helped to make this meeting a success.

Valery V. Tuchin
Lihong Wang