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# ***Complex Dynamics and Fluctuations in Biomedical Photonics IV***

**Valery V. Tuchin**  
*Editor*

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**Valery V. Tuchin**, Saratov State University (Russia)



## Introduction

These proceedings are from the conference on Complex Dynamics and Fluctuations in Biomedical Photonics IV, held January 20, 2007, during the SPIE Photonics West symposium in San Jose, California. It was a two-day meeting featuring 36 oral and poster presentations from leading international research groups.

The goal of the conference was to gather essentially different groups of leading researchers and students — such as biophysicists, physicians, mathematicians, optical and laser engineers — to facilitate future progress in the development of optical and laser technologies based on complex dynamics and fluctuations approaches towards biomedical science and clinical applications. These approaches should be useful for diagnosis and therapy of dangerous diseases such as those of the heart and vascular systems, and cancer, psoriasis, mental illness, and many other conditions 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 such interdisciplinary fields of science and applications 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; Biophotonic Imaging, Spectroscopy, and Microscopy; Blood and Lymph Flow Complex Dynamics; Adaptive Systems and Nonlinear Dynamic Processes; and Dynamics of Laser-Induced Nanoparticle Photothermolysis; with six invited papers.

During the oral session on Coherent-Domain Methods for Monitoring of Tissue Complex Structure and the poster session, studies of dynamical processes in biomedicine using high-speed spectral OCT, including early development of chick embryonic heart imaging at 766nm in vivo with high-fidelity, were presented and discussed. Results of basic research on the information capacity of coherence-gated imaging through turbid media and penetration depth of low-coherence enhanced backscattering photons in the subdiffusion regime were also analyzed. Tapered single-mode fiber tip for high lateral resolution imaging in OCT was described. Two papers on speckle technologies, such as speckle tracking-based elastography for skin monitoring and a signal-to-noise analysis for laser speckle contrast imaging, were presented.

In the session on Biophotonic Imaging, Spectroscopy, and Microscopy, cell structure and dynamics using confocal light scattering and absorption

spectroscopic microscopy, new Monte Carlo-based diffuse optical imaging technique, the computed radiography x-ray phase contrast imaging system, the influence of nutrition and stress factors on the antioxidative potential of the skin, two-photon microscopy image slices restoration using modified nonlinear anisotropic diffusion filter, and spectral changes in skin autofluorescence under application of different clearing agents were analyzed and discussed.

The Blood and Lymph Flow Complex Dynamics session included a few papers on complex effects of erythrocyte aggregation on optical transmission of blood, on in vivo measurement of blood aggregation by using DLS, and on advanced in vivo microscopy for monitoring of cell flow dynamics, on in vivo integrated lymph and blood flow cytometry for real-time monitoring of cell blood-lymph traffic, and cell-cell interaction in blood flow in patients with coronary heart disease (in vitro study).

In the session on Adaptive Systems and Nonlinear Dynamic Processes and the corresponding portion of the poster session, the following topics were discussed: current adaptive optic ophthalmologic techniques and new methods of increasing field-of-view of fundus cameras, nonlinear dynamics in liver cell metabolism modulated by mitochondrial dysfunction, near-infrared fluorescence dynamic optical imaging of lymphatic vasculature, noise-induced firing patterns in generalized neuron model with subthreshold oscillations, tactile information processing in the trigeminal complex of the rat, and variations of piece-wise linear 1D map modeling neuron activity.

During the session on Dynamics of Laser-Induced Nanoparticle Photothermolysis two main topics were discussed: laser-induced thermal explosion mode for selective nano-photothermolysis of cancer cells and chaos in the pressure generated by laser absorption by microparticles.

In addition to these topics, the following problems also were discussed in the poster session: mining and learning latent dynamics in biological manifolds, light scattering application for bacterial cell monitoring during cultivation process, changes in efficiency of optical clearing of mouse skin in vivo and in vitro induced by different alcohol agents, Monte Carlo study of skin optical clearing to enhance light penetration in the tissue, near-infrared absorbance measurements of hemoglobin solutions incubated with glucose, and monitoring of hemoglobin glycation using spectral and refraction measurements.

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

**Valery V. Tuchin**