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Laser Physics and Photonics XVIII; and Computational Biophysics and Analysis of Biomedical Data IV

Vladimir L. Derbov

Dmitry E. Postnov

Editors

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- 2 Computational Biophysics and Analysis of Biomedical Data IV
Dmitry E. Postnov, Saratov National Research State University (Russian Federation)

Introduction

The 5th International Symposium on Optics and Biophotonics (Saratov Fall Meeting: SFM17) was held in Saratov, Russian Federation, 26–30 September 2017 with over 500 participants from the Russian Federation, United States, Canada, and Europe, Asia, and Pacific Ocean countries. It covered a wide range of modern problems of fundamental and applied optics, laser physics, photonics, and biomedical optics.

This volume includes selected papers from the following conferences and workshops organized in the framework of the symposium:

Laser Physics and Photonics XVIII

Vladimir L. Derbov (*Chair*)

Computational Biophysics and Analysis of Biomedical Data IV

Dmitry E. Postnov (*Chair*)

The first part of the volume, devoted to laser physics and photonics, begins with the papers related to lasers and their applications, including high-power chemical lasers, THz sources, and a variety of semiconductor laser systems. Among the applications: the fundamental problem of particle creation from a vacuum in the super-intense laser field is worth particular interest. The next two sections include the papers on nonlinear optical interactions, beam and pulse propagation, and image formation. The newest and most interesting results here are related to soliton dynamics, propagation of polarized pulses under the conditions of self-induced transparency, as well as the formation and application of nontrivial laser beams possessing optical vortices.

The Saratov Fall Meeting traditionally gives the floor to the discussion of the urgent problems of quantum optics. In the present volume, the papers related to quantum optics and non-classical light mainly focused on theoretical interpretation of fundamental quantum optical experiments, particularly those related to the formation and application of entangled quantum states, which are expected to play a crucial role in the implementation of quantum computers, encryption, and networks. A variety of new objects exposed to laser irradiation and novel light-matter interactions beyond the limits of classical optics that belong to a more general field of photonics, naturally, require novel theoretical and numerical approaches. Alongside traditional software development, and computer simulations of particular systems interacting with laser radiation, the papers of the present volume consider a fundamental issue of geometrization of Maxwell theory and its practical outcome.

As compared to the analogous volume of SFM 2016 Proceedings (Proceedings volume 9917), two new sections have been added. One section is devoted to

electrodynamics of photonic systems; particularly the interaction of electromagnetic waves with artificial media including metamaterials. The laser section was comprised of papers reporting the analysis of randomly inhomogeneous media (foams, gel suspensions, etc.) using polarization optics, light diffusion, and speckle correlometry techniques.

The second part of the volume was devoted to computational biophysics and analysis of biomedical data. Here, the hot topic appeared to be the variety of measurement techniques and data processing algorithms relevant to brain studies. Specifically, the sophisticated methods of EEG analysis are presented in order to link the recorded signals with patterns of complex motor activity, or to test the basic psycho-physiological features of a person, or to provide the effective control of anthropomorphic robotic arm. Another notable trend in this field was based on increasing evidence that the account of integrity of brain functions can open the door to future research progress. The electrical activity of a brain alters its physiological state in terms of ionic concentrations, and vice versa, the effectiveness of drainage of brain tissues supports or complicates normal information processing. In this regard, the number of presented studies were devoted to the study of meningeal lymphatic system, to the brain tissues volume measurements, and to modeling of astrocyte network functions.

Another important problem addressed in the volume was computational issues relevant to microcirculation studies. The presented problem-specific algorithms and numerical methods range from non-contact method of search and analysis of pulsating vessels, automated analysis of plethysmograms or fNIRS response, through modeling studies on conducted vasoreactivity and heart-rate dynamics during orthostatic test.

Last but not least there were contributions of general interest providing the receipts or just the hints for the variety of biocomputing needs. Worth mentioning is the paper on practice-based approach to LASCA, as well as a description of generic mechanisms for the target patterns formation in a stochastic bistable excitable media.

This is the second volume of the Saratov Fall Meeting 2017 Proceedings. The preface to the first volume, Optical Technologies in Biophysics & Medicine XIX (volume 10716), edited by Elina A. Genina and Valery V. Tuchin, provided the reader with thorough and impressive information about the entire event of Saratov Fall Meeting 2017.

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