

The scientific program of the VIII International Symposium on Optics and Biophotonics

Date 29/09/2020

Opening of the International Symposium on Optics and Biophotonics

Plenary Session I

Plenary Session II

Special Event: Sponsorship Session

Date 30/09/2020

Plenary Session III

Parallel oral sessions of conferences and seminars:

Section: Optical technologies in biophysics and medicine XXII (session I, II)

Brief description of the section: The main goal of the conference is to present and discuss the latest developments and applications of laser and optical technologies in medicine and biology. The main focus will be on the discussion of basic research and the application of coherent, low coherent, polarized, spatio-temporal modulated light interactions with inhomogeneous absorbing media, tissue phantoms and various types of tissue in vitro and in vivo.

Such phenomena as elastic, inelastic and dynamic light scattering, the Doppler effect, nonlinear effects, photoacoustic and photothermal interactions, mechanical stresses, and photobiological effects will be considered. On this basis, a variety of laser and optical technologies for medical diagnostics, therapy, surgery and light dosimetry will be analyzed.

Lasers and optical methods for cardiology, dermatology, ophthalmology, gynecology, dentistry and other fields of medicine will be presented. The issues of light scattering and photochemical methods as applied to cell biology and microbiology will also be discussed.

Topics:

- Migration of photons in tissue**
- Diffuse-wave and correlation spectroscopy of tissues**
- Spectrophotometry, fluorescence and Raman spectroscopy of tissues**

- **Static and dynamic light scattering in tissues**
- **Coherent optical methods for medical diagnostics**
- **Coherent microscopy of cells and tissues**
- **Optical diffusion and coherent medical topography and tomography**
- **Laser Doppler measuring systems for medicine and biology**
- **Full-field speckle-correlation biomedical technologies**
- **Optical methods for measuring bio-vibration**
- **Optical polarimetric methods for the study of tissues and cell structures**
- **Photothermal and photoacoustic methods for tissue diagnosis**
- **Optical biopsy**
- **Optical microelastography of tissues**
- **Osmotic effects and optical monitoring of diffusion of substances into tissues**
- **Optical enlightenment of tissues and blood**
- **Optical glucose detection**
- **Laser and optical technologies in microbiology**
- **Designing fabric phantoms**
- **Photochemical, photothermal and photobiological effects, phototherapy mechanisms**
- **High-energy laser interactions with cells and tissues, methods of laser surgery**
- **Lasers and optical technologies in dermatology, ophthalmology, gynecology, cardiology, dentistry, etc.**
- **Microchannel and photonic crystal technologies in biology and medicine**
- **Biosensors**

Section: Computational Biophysics and Analysis of Biomedical Data VII (session I, II)

Section brief description: Mathematical modeling and computational methods are powerful tools for modern research. Together with advanced methods for analyzing experimental data, they provide a solid computing base for both experimental and theoretical research in the field of biophysics and medicine.

The set of approaches and methods of mathematical modeling is becoming a powerful tool for biomedical research in general and drug development in particular. The frequently used terms “Biosimulation” or “Biocomputing” mean a combination of different levels and modeling techniques ranging from a phenomenological to a detailed description of biochemical processes, which is used both to identify the basic physical mechanisms and to predict the quantitative characteristics of processes in living systems.

The rapid development of optical and non-optical methods of visualization and measurement is accompanied by a significant increase in the flow of source data. Thus, there is a significant need for a continuous increase in data processing capabilities, both quantitative (computational performance) and qualitative (adaptive and problem-oriented data preprocessing). The use of GPUs that implement affordable parallel computing technologies is becoming a popular solution that provides high performance at a reasonable cost. However, this requires the adaptation of existing and the development of new computational algorithms for filtering and detecting patterns of spatio-temporal dynamics. Alternative implementations of wavelet and causality analysis are still under development and are ready to provide new approaches to the analysis of complex data, revealing the structural features of the original system, such as the interaction of internal rhythms, the relationship between the components of the system or the interdependence of events. In this area, the development, testing, and experience of applying both temporal and spatial complexity measures, such as multimodal wavelet analysis, fractality measurement, etc., are very important.

The main goal of the conference is to provide a platform for discussing the topics listed in the framework of the Symposium with special attention to problem-oriented approaches to solving problems. The latter means that reports based on experimental studies showing the need for specific computational methods are also welcome.

Topics

- The scientific program includes, but is not limited to the following topics:
- Mathematical modeling of biochemical and physiological processes
- Advanced time series analysis for biomedical applications
- Computational neuroscience

- **Dynamic patterns in experimental physiology**
- **Computational technologies in biomedical data processing**
- **Measures of complexity, pairing and rhythm detection techniques**

Section: Microscopic and Low Coherent Methods in Biomedical and Non-Biomedical Applications XIII

Section brief description: The development of non-invasive or minimally invasive methods for visualizing, monitoring and quantifying various materials and processes is extremely important for many biomedical (including therapy, diagnostics, management and advanced visualization of various destructive diseases) and non-medical applications (size metrology, material research and non-destructive testing, artistic diagnostics, botany, microfluidics, data storage and security applications). This section will focus on two aspects of optical imaging: microscopy and low coherence interferometry.

Section: Biomedical Spectroscopy VI (Session I, II)

Brief description of the section: The conference topics cover a wide variety of spectroscopic techniques as applied to the study of biological objects, including the human body, as well as to the study of modern and constantly updated biomaterials. The issues under discussion are also related to the basic principles of obtaining reliable spectral data in the analysis of optically heterogeneous objects of complex chemical composition and using both routine spectroscopic methods and non-standard approaches in environmental studies. Among the conference reports, we expect to hear speeches by leading experts, where students and graduate students will be able to hear first-hand about current research and recent advances in biomedical spectroscopy.

Topics:

The problems and content of the scientific program of the conference include (but are not limited to) the following thematic sections:

- **Spectral characteristics of nanoparticles and nanostructures used in optical diagnostics and theranostics;**
- **Spectroscopic aspects of optical biopsy;**

- **Nano- and molecular probes;**
- **Laser spectroscopy of biological objects and biomaterials;**
- **Spectroscopic methods of environmental monitoring;**
- **“Pitfalls” in spectroscopic measurements and ways to get around them;**
- **In vivo and in vitro measurements;**
- **Spectroscopy of random and ordered media;**
- **Polarization spectroscopy;**
- **Spectroscopic measurements on tissue phantoms.**

Section: New Materials for Optics and Biophotonics III (Session I, II)

Brief description of the section: Within this section, reports will be presented on the latest achievements in the development of new biocompatible materials with unique optical properties for medical instruments used for diagnosis, treatment and implantation. The current issues of tissue transplantation, physics of colloidal systems and 3D bioprinting will also be discussed.

Section: Spectroscopy and Molecular Modeling XXI (Session I)

Brief description of the section: this section will discuss theoretical and experimental methods of spectroscopy and molecular modeling to study the structure and properties of atomic and molecular systems.

Topics

The scientific program will include the following thematic areas, not limited to:

- **IR spectroscopy**
- **Raman spectroscopy**
- **Fluorescence spectroscopy**
- **Atomic spectroscopy**
- **Molecular modeling (methodological aspects and applications)**

Section: Laser Physics and Photonics XXII (Session I)

Brief description of the section: The main goal of the conference is to attract young scientists and students to research in the field of the latest achievements in laser physics and photonics, including their applications. The main attention will be paid to the discussion of the physical processes underlying the operation of lasers, advances in the development and application of lasers, as well as the quantum and coherent properties of light and a wide range of problems of the interaction of light with matter, including both macro- and microscopic effects. The physics and technology of optical fibers and networks, photonic crystals, optoelectronic and acousto-optical devices will be discussed.

Topics

- **Physical processes in lasers, dynamics of laser systems**
- **Optical waveguides, fiber optics, optical networks**
- **Photonic crystals**
- **Propagation of laser beams and pulses, optics of ultrafast processes**
- **Interaction of laser radiation with matter, nonlinear optics**
- **Quantum optics, photon statistics**
- **Acoustooptics**
- **Optoelectronics**
- **Photonics of low-dimensional structures**
- **Laser spectroscopy**
- **Coherence and holography**

Provisional list of sessions:

- **Nonlinear dynamics of lasers and optical systems.**
- **Optical coherence and holography**
- **Nonlinear propagation of beams and pulses, optics of ultrafast processes**

- **New directions in computer simulation of lasers and optical systems**
- **Atomic and quantum optics, optical devices for quantum computing, photonics of exotic quantum systems**
- **Laser physics and its applications**
- **Nonlinear optics**
- **Dynamics of atoms, molecules and quantum systems in laser fields**
- **Photonic crystals and optical waveguides based on them**

Section: Quantum Science and Technology (Session I)

Brief description of the section: The section is devoted to the problems of modern quantum technologies - instruments and devices operating using the properties of individual quantum systems, such as superposition and entanglement. Using quantum technologies, it will be possible to create high-performance computing devices, secure communications and ultra-sensitive measuring devices.

Section Topics:

- **Quantum computing**
- **Quantum simulators**
- **Quantum emulators and simulation of quantum systems**
- **Quantum communications and quantum cryptography**
- **Quantum sensors and metrology**
- **Quantum Optics**

Date 01/10/2020

Plenary Session IV

Parallel oral sessions of Conferences and Workshops:

Section: Optical Technologies in Biophysics and Medicine XXII (Session III)

Section: Laser Physics and Photonics XXII (Session II, III)

Section: Quantum Science and Technology (Session II)

Section: Nanobiophotonics XVI (Session I)

Brief description of the section: The section is devoted to research in the field of synthesis, functionalization, and applications in the field of biophotonics of various nanoparticles and nanostructured materials. Particular attention is paid to the development of technology of nanoparticles with plasmon resonance, SERS tags and quantum dots.

Section Topics:

- **Synthesis of plasmon resonance nanoparticles (NPs) and nanostructures**
- **Multifunctional nanostructures for theranostics**
- **Composite nanostructured functional materials**
- **Optical properties of plasmon resonance NPs and nanostructures**
- **Physico-chemical characteristics of NPs and nanostructures**
- **LF functionalization with biospecific macromolecules**
- **Nanoscale biosensors**
- **LF-based chemical technology**
- **Bioimaging of cells using NP conjugates**
- **Photothermal and photodynamic therapy using nanocomposites**
- **The use of NPs for targeted drug delivery**
- **Absorption of NP cells**
- **Biodistribution and toxicity of NPs in invitro and invivo systems**
- **Application of LF and bioconjugates in analytics**
- **SERS using plasmon nanostructures**
- **SEC tags as a new type of nanoprobe**
- **Quantum dots and their application**

Section: Terahertz Optics and Biophotonics III

Brief description of the section: Within this section, reports will be presented on the latest achievements in the field of development and biomedical applications of THz technology. The main activities of the section will include a discussion of fundamental and applied problems, in particular, the computational and experimental problems of THz technology, THz spectroscopy and imaging systems, the development and manufacture of components, the interaction of THz radiation with living tissues and cellular structures. The possibility of using THz radiation for non-invasive, minimally invasive and intraoperative diagnosis of malignant tumors will also be discussed.

Section: Nonlinear Dynamics XI

Brief description of the section: The main goal of the seminar is to attract students and young scientists to discuss current problems and the latest results in the field of theoretical nonlinear dynamics. Particular attention at the seminar will be paid to the use of nonlinear dynamics methods in the study of living systems, mathematical physiology, neuroscience, as well as time series analysis in biophysics and medicine. In addition, modern achievements in the field of studying the dynamics of complex nonlinear systems, deterministic and stochastic, will be considered. It is assumed that during the seminar leading experts in the above areas will give lectures, and young scientists, graduate students and students will present oral and poster presentations.

Workshop topics

The seminar program includes (but is not limited to) the following sections:

- **Nonlinear dynamics of deterministic finite-dimensional and distributed systems**
- **Bifurcation and stability**
- **Synchronization of complex processes**
- **The role of fluctuations in nonlinear dynamics**
- **Diagnosis and analysis of physiological rhythms**
- **Mathematical modeling of living systems**

Section: Low Dimension Structures X

Brief description of the section: The main purpose of the seminar is to discuss current problems and recent achievements in the field of experimental and theoretical study of structural features and properties of low-dimensional structures. Particular attention at the seminar will be given to the use of low-dimensional structures as biomaterials for biomedical applications. In addition, the seminar will discuss various aspects of nanobiomechanics, molecular dynamics, nanobioelectronics.

Conference Topics

The conference program includes (but is not limited to) the following sections:

- technology for the synthesis of low-dimensional structures (nanofilms, nanocoatings, nanotubes, nanowires, graphene, fullerenes);
- atomic structure and properties of low-dimensional structures and methods for their study;
- low-dimensional structures in external fields;
- biomedical and non-biomedical applications of low-dimensional structures;
- molecular modeling of diffusion mechanisms of lipid-protein complexes in the intima of arteries.

Plenary Session V

Joint Poster Session

Date 02/10/2020

Plenary Session VI

Award ceremony of the winners of the competition for the best poster presentation among students and graduate students

Parallel oral sessions of conferences and seminars:

Section: Optical Technologies in Biophysics and Medicine XXII (Session IV)

Section: Computational Biophysics and Analysis of Biomedical Data VII (Session III)

Section: Nanobiophotonics XVI (Session II)

Section: Spectroscopy and Molecular Modeling XXI (Session II)

Section: Electromagnetism of microwaves, submillimeter and optical waves X

Brief description of the section: The main purpose of the section is to present and discuss modern developments in the field of electromagnetism, electromagnetic methods in optics, laser physics, photonics, plasmonics, calculation and analysis of photonic, plasmon and magnon crystals and metamaterials, application of electrodynamic approaches to modeling non-linear and non-stationary processes.

Topics

- **Antennas and Propagation**
- **General theory of electromagnetic field**
- **Non-stationary electrodynamics**
- **Excitation and propagation of impulses**
- **Plasmonics and nanoplasmonics**
- **Nonlinear electrodynamics and electronics**
- **Diffraction and scattering of waves**
- **Resonators, waveguides, heterogeneities in transmission lines, microwave devices**
- **Radiophysics and electronics of microwaves, millimeter, submillimeter and optical waves**
- **Electromagnetic methods in optics**
- **Electromagnetism in biomedical applications**
- **Electromagnetism of condensed and artificial media**
- **Metamaterials, photonic crystals, left-handed media**
- **Sensors and measurements**

- **Boundary value problems and algorithms**

Section: Modern polarization and correlation technologies in biomedicine and materials science VII

Brief description of the section: The scientific program of the section covers the following areas: traditional approaches and new views on the basic laws of the propagation of polarized radiation in various media and the features of the interaction of polarized coherent radiation with matter; basic principles and possibilities of using singular optics and the theory of optical vortices; polarized light in biomedicine - from simple devices to complex applications; design and practical use of probes and sensors based on polarization in various fields of modern science and technology; birefringence, optically active and chiral homogeneous and heterogeneous natural and artificial media, etc.

The main objectives of the Workshop:

- **Presentation of modern key results and achievements in the field of polarization and correlation diagnostics of randomly inhomogeneous media;**
- **a discussion of the fundamental aspects of the propagation of polarized coherent and incoherent radiation in scattering and absorbing media with a complex structure;**
- **discussion of the possible applications of spectral polarization and coherent optical methods for morphofunctional diagnostics in medicine and for the analysis of micro- and nanostructured dispersed media and composite materials in materials science;**
- **the involvement of young scientists and students in an active and productive initial activity in the fields of fundamental and applied optics, laser physics and photonics.**

The main Topics of the Workshop

The program of the Workshop includes the following main sections, which are not a strict restriction on the topics of the reports presented:

- **fundamental features of the propagation of polarized light in randomly inhomogeneous media and the relationship between the coherent and polarization properties of the propagating waves - traditional and new approaches;**
- **basic principles and practical applications of singular optics and the theory of optical vortices;**

- **polarized light in biomedicine - from simple approaches to complex solutions;**
- **development and practical application of polarization and coherent-optical probes and sensors in various fields of modern science and technology;**
- **anisotropic, optically active and chiral spatially homogeneous and heterogeneous natural and artificial environments;**
- **resonant interactions of light with matter at nanometer scales and their manifestations in the polarization properties of scattered radiation;**
- **analytical and numerical approaches in modeling the transfer of polarized radiation in multiply scattering media.**

Closing of the International Symposium on Optics and Biophotonics

Chairman of the Program Committee



Tuchin V.V.