



**Saratov State
University (National
Research University
of Russia)**

**Research-Educational
Institute of Optics
& Biophotonics**

Dedicated to the 110th Anniversary of
Saratov State University

Saratov Fall Meeting SFM'19

XXIII International School for Junior Scientists and Students on Optics, Laser Physics & Biophotonics

**September 23 - 27, 2019
Saratov, Russia**

School Chair

Valery V. Tuchin, Saratov State
University; Institute of Precision
Mechanics and Control RAS; Tomsk
State University (Russia)

School Secretaries

Irina Yu. Yanina, Saratov State
University; Tomsk State University
(Russia)

Workshops:

- **Modern Optics XVIII** (*Georgy V. Simonenko*)
- **English as a Communicative Tool in the Scientific Community XVIII** (*Alexander B. Pravdin, Svetlana V. Eremina*)
- **Workshop on Management of High Technologies Commercialization and Regional Innovation Systems XVI** (*Julia S. Skibina, Valery V. Tuchin*)
- **History, Methodology and Philosophy of the Optical Education XII** (*Boris A. Medvedev, Vladimir P. Ryabukho*)

Co-located with:

International Symposium on Optics and Biophotonics –VII (Saratov Fall Meeting SFM'19 – Symposium, **September 24 - 27, 2019**)

SPIE SC:

Optical imaging systems to guide surgery and radiation therapy

Brian W Pogue

Thayer School of Engineering, Dartmouth-Hitchcock Medical Center, Hanover, USA

OSA SC:

Functional optical imaging of developmental dynamics *in vivo*

Irina V. Larina

Baylor College of Medicine, Houston, USA

Public lectures:

Shining light on the miracle of life

Irina V. Larina

Baylor College of Medicine, Houston, USA

Special events:

Science incubator for school children and students on Photonics

Plenary and invited speakers

Optical coherence tomography and optogenetics for investigation of early mammalian embryonic development

Irina V. Larina

Baylor College of Medicine, Houston, USA

New multimodal and biocompatible contrast agents for single cell diagnosis and therapy *in vivo*

Ekaterina Galanzha

University of Arkansas for Medical Sciences, Little Rock, AR, USA

Exogenous fluorescence diagnostics of gastrointestinal tumours

Ekaterina Borisova

Institute of Electronics, Bulgarian Academy of Sciences, Sofia, Bulgaria

Optical clearing in the UV region – in search for new diagnostic procedures

Isa Carneiro, Sónia Carvalho, Rui Henrique, Luís Oliveira, Valery V. Tuchin

Polytechnic Institute of Porto, Porto, Portugal

Estimation and analysis of skin autofluorescence, scattering and absorption properties under optical clearing

Walter Blondel

Université de Lorraine – CRAN, France

Autofluorescence-based Redox status as a differential diagnostic parameter of skin carcinomas

Marine Amouroux

Université de Lorraine – CRAN, France

Optical Elastography – an Emerging Techniques to Assess Tissue Health

Kirill Larin

University of Houston, USA; SSU, TSU

Terahertz pulsed spectroscopy of blood components for medical diagnosis.

Olga P. Cherkasova

Institute of Laser Physics SB RAS, Novosibirsk State Technical University, Novosibirsk; Tomsk State University, Tomsk, Russia

Speckle Dynamics – From Diffuse Correlation Spectroscopy through Laser Speckle Contrast Imaging to Ultrasound Velocimetry

David Boas

Boston University, Boston, USA

Upconverting nanoparticles applied in tissue imaging

Stefan Andersson-Engels

Irish Photonic Integration Centre (IPIC), Tyndall National Institute and Department of Physics, University College Cork, Ireland

Correlation of hemorheologic parameters measured in vitro and in vivo by different optical techniques in patients suffering from various socially important diseases

Alexander V. Priezzhev

M.V. Lomonosov Moscow State University, Moscow, Russia

Biomedical Optoacoustics: A new theranostic modality

Rinat O. Esenaliev

University of Texas Medical Branch, Galveston, Texas, USA

Optics based assessment of brain stiffness

Teemu Myllylä

University of Oulu, Finland

Terahertz pulsed spectroscopy of blood components for medical diagnosis.

Olga P. Cherkasova

Institute of Laser Physics SB RAS, Novosibirsk State Technical University, Novosibirsk; Tomsk State University, Tomsk, Russia

Internet plenary and invited speakers

In Vivo Multiphoton Microscopy and Multiphoton Photothermolysis Therapy

Haishan Zeng

University of British Columbia, Vancouver, Canada

The new role of diamond in technology - fiber-optic sensors with diamond layers

Małgorzata Szczerka

Gdańsk University of Technology, Gdańsk, Poland

Modified normalization method in microscopic analysis of the stratum corneum

M.E. Darvin, C.S. Choe, S. Choe, J. Schleusener, J. Lademann

Charité-Universitätsmedizin Berlin, Germany

Remote photonic sensing of brain activity

Zeev Zalevsky

Bar Ilan University, Israel

From millimeters to nanometers –
reducing the scale in microscopy

Herbert Schneckenburger

Aalen University, Aalen, Germany

Interaction of red blood cells incubated
with engineered nanoparticles assessed
by optical tweezers and SEM imaging

Alexey P. Popov

University of Oulu, Finland

Safety verification of nanoparticles for
biomedical application from the
viewpoint of blood microrheology

Andrei E. Lugovtsov

M.V. Lomonosov Moscow State University,
Moscow, Russia

Time-resolved near-infrared optical
tomography of neonatal brain

Alexander Kalyanov

University of Zurich, Zurich, Switzerland

Porous oxide 3D nanostructures and
nanocomposites as new functional
materials: prospects of the applications
for information transfer devices, in
optics and photovoltaics

Anatoly N. Khodan

Frumkin Institute of Physical Chemistry
and Electrochemistry of the RAS, Moscow,
Russia

Quantum optical technologies for
communications and information
processing

Alexei K. Fedorov

Russian Quantum Center, Skolkovo,
Russia; University of British Columbia,
Vancouver, BC, Canada

Quantum cascade lasers for mid-
infrared and terahertz range

Grigori Sokolovskii

Ioffe Physical-Technical Institute,
Russia.

Organized by

Saratov State University (National
Research University of Russia) (SSU)
Research-Educational Institute of
Optics and Biophotonics, SSU
International Research-Educational
Center of Optical Technologies for
Industry and Medicine "Photonics",
SSU

Institute of Biochemistry and
Physiology of Plants and
Microorganisms, RAS
Institute of Precision Mechanics and
Control, RAS (IPMC RAS)
Saratov State Medical University
named after V.I. Razumovsky
Volga Region Center of New
Information Technologies, SSU
Tomsk State University (National
Research University of Russia) (TSU)
Biomedical Photonics Committee of
Chinese Optical Society, China
ITMO University
Bauman Moscow State Technical
University (BMSTU)

Institute of Solid State Physics of RAS
(ISSP RAS)
Prokhorov Institute of General Physics of
RAS
Sechenov First Moscow State Medical
University
Institute of Ultra High Frequency
Semiconductor Electronics of RAS
Bach Institute of Biochemistry, Research
Center of Biotechnology, RAS, Moscow
SPIE Student Chapters of SSU, BMSTU,
ISSP RAS, and Samara University
OSA Student Chapters of SSU and
BMSTU

In cooperation with

Academy of Natural Sciences, Saratov
Regional Division
Russian Society for Photobiology
Saratov Science Center, RAS
Biophotonics.World - the worldwide
consortium Biophotonics4Life
EPIC – European Photonics Industry
Consortium

Co-sponsored by

Government of the Russian Federation
RAS – Russian Academy of Sciences
SPIE – The International Society of
Photo-Optical Instrumentation Engineers
OSA – Optical Society of America
IEEE - Institute of Electrical and
Electronics Engineers

Russian Technology Platform "The
Medicine of the Future"

Russian Technology Platform "Photonics"

European Technology Platform
"Photonics21"

Samara University

INJECT RME LLC, Saratov, Russia

LLC SPE Nanostructured Glass Technology,
Saratov, Russia

Program Committee

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USA; SSU, TSU

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"Nanostructured Glass Technology"

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Technical University n.a. Yuri Gagarin

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Kirill I. Zaytsev

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Michael M. Slepchenkov & Ivan V. Fedosov, Saratov State University

Members

Maxim Malovetsky, SSU

Andrey V. Slepnev, SSU

Maxim A. Kurochkin, SSU

The main goal of the School is to involve junior researchers and students in the field of recent developments and applications of laser and optical technologies in medicine and biology, coherent optics of random and ordered media, material and environmental sciences, nonlinear dynamics of laser systems, laser spectroscopy and molecular modeling, nanophotonics and nanobiophotonics. The main attention will be paid to discussion of fundamentals and general approaches of description of coherent, low-coherent, polarized, spatially and temporally modulated light interactions with inhomogeneous scattering media, photonic crystals, nanoparticles, tissue phantoms, and various types of tissues *in vitro* and *in vivo*. Such effects as static and dynamic light scattering, Doppler effect, Raman scattering, SERS, CARS, SHG, multiphoton fluorescence,

optoacoustic and optothermal interactions, mechanical stress, photodynamic effect, etc will be considered. On this basis, the variety of laser and optical technologies for medical diagnostics, therapy, surgery, and light dosimetry, as well as for spectroscopy of random and ordered tissue will be presented.

SFM-18 will be organized as the Short Courses, morning plenary sessions, afternoon lecture and oral sessions, and evening poster presentations. The original oral reports and posters will be presented by the junior scientists and students. Plenary lectures will be presented by well-recognized experts in the field.

Last year short courses

OSA SC:

Diffuse Laser Speckles and their Statistics for Non-Invasive, Deep Tissue Blood Flow Measurements

Turgut Durduran

ICREA Professor at ICFO -The Institute of Photonic Sciences, Barcelona, Spain

SPIE SC1:

Fluorescence Guided Procedures and Photodynamic Therapy in Neurosurgery

Ronald Sroka

LIFE-Center at Department of Urology at Hospital of University of Munich, Munich, Germany

SPIE SC2:

Optical Dosimetry of Clinical Light Treatments

Anna N. Yaroslavsky

Department of Physics, University of Massachusetts, Lowell, USA

Last year plenary speakers

Quantifying stability in deterministic and stochastic complex systems

Jürgen Kurths

Humboldt University, Physics Department and Potsdam Institute for Climate Impact Research, Potsdam, Germany

Optical study of molecular and microrheologic mechanisms of interaction and alteration of blood components in the microcirculatory system

Alexander V. Priezzhev

M.V. Lomonosov Moscow State University, Russia

Biological tissue optics and optical clearing

Valery Tuchin

Saratov State University; Institute of Precision Mechanics and Control RAS; Tomsk State University (Russia)

Plasmonic SERS tags with embedded Raman molecules for bioimaging and sensing applications

Nikolai G. Khlebtsov

Institute of Biochemistry and Physiology of Plants and Microorganisms of the RAS, Saratov State University, Russia

Optical dosimetry of extraoral photobiomodulation therapy of oropharyngeal mucositis in pediatric patients undergoing hematopoietic cell transplantation

Anna N. Yaroslavsky

Advanced Biophotonics Laboratory at the Department of Physics, University of Massachusetts, Lowell, US

Approaches of the molecular imaging and machine learning for medical applications

Yury V. Kistenev, Alexey V. Borisov, Viktor V. Nikolaev, Denis A. Vrazhnov, Anastasya I. Knyazkova

Tomsk State University; Siberian State Medical University, Russia

How to measure tissue blood flow non-invasively with light and what are the current trends?

Turgut Durduran

ICFO-The Institute of Photonic Sciences, Barcelona, Spain

Advanced technologies for brain

Metin Akay

University of Houston, USA

Microscopy of the brain on the basis of generation of optical harmonics: in search of optimum

Ilya V. Fedotov

M.V. Lomonosov Moscow State University, Russia

Photonic and magnetic nanoparticles for health, energy, and biosensing

T. Randall Lee

University of Houston, USA

Superconducting thin film nanostructures as terahertz and infrared heterodyne and direct detectors

Grigory N. Goltsman

Moscow State Pedagogical University, Russia

Stone fragmentation in urology

Ronald Sroka

LIFE-Center at Department of Urology at Hospital of University of Munich, Munich, Germany

Imaging below the diffraction limit by spectroscopic signal separation using quantum dots

Andrei Sapelkin

Queen Mary University of London, UK

Biphoton emission and absorption processes

Vladimir Gorelik

P.N. Lebedev Physical Institute of the RAS, Russia

Optical detection of clinical pathologies by image and spectroscopic analysis

Francesco S. Pavone

European Lab. for Non-linear Spectroscopy, Florence, Italy

In vivo flow cytometry for detection of silent circulating tumor cells in melanoma

Ekaterina I. Galanzha

University of Arkansas Medical Science, USA.

Recent advances in embryonic imaging and tissue elastography

Kirill Larin

University of Houston, USA

Photodiagnostics of stress-induced gastrointestinal neoplasia

Ekaterina Borisova et al.

Institute of Electronics, Bulgarian Academy of Sciences, Sofia, Bulgaria; Saratov State University, Russia.

Nanosatellite Biomedical Experiments in Space

Valery P. Zakharov

Samara University, Russia

Last year internet plenary speakers

Ubiquitous THz photonics from ultra-high bit-rate communications to super-resolution non-destructive imaging

Maksim Skorobogatiy

Polytechnique Montreal, Canada

Non-invasive optical imaging of tissue microstructure and microcirculations in vivo

Ruikang K. Wang

University of Washington, USA

Biomedical applications of terahertz - applications, opportunities and challenges

Vincent P. Wallace

University of Western Australia, Australia

Participants from Russia, USA, UK, Germany, France, Belgium, Switzerland, Sweden, Taiwan, Italy, Denmark, the Netherlands, Slovenia, Finland, Ukraine, Belarus, Poland, Bulgaria, Ireland, Israel, Turkey, China and others have located their papers at the meeting website:

<http://sfm.eventry.org/2019/>

Among invited Internet lecturers were well recognized experts in the fields of biomedical optics and light scattering.

Official languages of the School and the

Workshops are English and Russian, translation will be provided.

The Conference fee

For foreign participants, the conference fee is \$200 (lunches, barbecue, Volga-river voyage, and light refreshments are included), may be paid during the Meeting or transferred to the account number for request.

For Russian participants the Conference fee will depend on financial support from sponsoring organizations.

Lodging

Western style mini-hotel Bohemia in the downtown

<http://www.bohemiahotel.ru>

Hotel "Slovakia" ashore the Volga river

<http://slovakia.all-hotels.ru/>

Hotel "Volga" in the downtown

<http://astoria-saratov.ru/en/hotels/volga/>

Hotel "Saratov" in the downtown

<http://astoria-saratov.ru/en/hotels/saratov/>

Hotel "Volna" ashore the Volga river

<http://volna64.ru/>

Culture program

Visits to Conservatoire, Theaters, and Museums, 2-hour Volga-tour.

Registration

Electronic registration before

April 15, 2019, at

<http://sfm.eventry.org/school2019/is> required.

Submission of Abstracts

Each author is requested to submit a one-page abstract. Abstract must be uploaded to the Conference website <http://sfm.eventry.org/school2019/> before **April 15, 2019**.

Proceedings

Conference papers will be published as Conference Proceedings (in Russian and English) under the title "Optical Physics and Biophotonics", SPIE Proceedings, and in Russian and International peer-reviewed journals: *Journal of Biomedical Photonics & Engineering*, *Quantum Electronics (Russian/English)*, *Optics and Spectroscopy (Russian/English)*, *Nonlinear Applied Physics (Russian/English)*.

Last year Conference Proceedings:

<http://optics.sgu.ru/media/library/pop/sfm-2018.pdf>

All papers will be subjected to the normal refereeing process for the

journals. Manuscripts of papers should be submitted not later than **November 1, 2019**. For special issue of Quantum Electronics not later than **August 15, 2019**.

<http://optics.sgu.ru/library/pop>

Visa application support

To apply for visa to Russian Consulate you need an official invitation letter. Procedure for letter preparation takes two months; the following information about you and accompany persons is needed:

1. Passport (valid up to six months after September 28, 2019) number: _____
dates of issue: ____ and of expiry: _____
(copy of passport page with photo)
2. Date of birth: ____, place of birth: _____
3. Living address: _____
4. Working position: _____
5. Working address: _____
6. Name of town, where you are going to apply for visa (Russian consulate)

Please, send this information to general secretary of the SFM-19.

Elina A. Genina: eagenina@yandex.ru

Important deadlines

**Submission of Abstracts – before
April 15, 2019**

**Visa application support –
information for official invitation
letter, before
May 31, 2019**

**Registration – before
August 1, 2019**

**Hotel reservation – before
August 1, 2019**

**Conference fee –
before September 25, 2019**

**Manuscripts submission – before
November 1, 2019**

SFM-19webpage:

<http://sfm.eventry.org/school2019/>

<https://www.facebook.com/groups/saratovfallmeeting/>

On behalf of the Organizing
Committee of SFM'19- School I have a
pleasure in inviting you to attend this
Meeting

Valery V. Tuchin

Workshop: **Modern Optics XVIII**

**Lectures on Optics for
University Students,
Postgraduate Students and
High School Students**

Chair

Georgy V. Simonenko, *Saratov State University*

Secretaries

Irina Yu. Yanina, *Saratov State University*

Program Committee:

Vladimir L. Derbov, *Saratov State University*

Ivan V. Fedosov, *Saratov State University*

Boris A. Medvedev, *Saratov State University*

Alexander B. Pravdin, *Saratov State University*

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Alexander V. Priezzhev, *Moscow State*

University

Vladimir P. Ryabukho, *Saratov State University*

Mikhail A. Starshov, *Saratov State University*

Valery V. Tuchin, *Saratov State University*

The main goal of the Workshop is promotion of school and high school youth achievements in optics - a thriving direction in physics.

One of the leading scientific schools of optics in Russia, which is a recognized authority in other countries formed in Saratov to date. Conferences, seminars and scientific schools are one of the effective ways to attract talented young people to scientific work, particularly in the area of optical research. Widening the circle of young people, the inclusion of students in high schools and colleges, including the physical, technical and other natural sciences field are one of the main tasks of scientific-methodical workshop on "Modern Optics".

Organized in cooperation with

Saratov Physics and Technical Lyceum
Lyceums No. 2, 4 and 15
Secondary schools No. 45, 51, 54, 67
and 77
Gymnasium No. 5

Ministry of Education of the Saratov Region

Workshop program

The program of the seminar "Modern Optics" consists of poster session "Science incubator for school children and students on Photonics", lectures and demonstration parts and seminars on selected topics. One lecture day with thematic sections supposed to hold the afternoon. Section sessions supposed to hold for 3-4 favorites, the most interesting topics for teachers, which posts students and pupils on the results of independent work is supposed to hear and discuss also.

Workshop

English as a Communicative Tool in the Scientific Community XVIII

Chairs:

Alexander B. Pravdin, Svetlana V. Eremina, *Saratov State University*

Secretary:

Natalia I. Kazadaeva, *Saratov State University*

International Program Committee

Vladimir L. Derbov, *Saratov State University*

Kirill V. Larin, *University of Houston, USA*

Martin Leahy, *National University of Ireland, Galway, Ireland*

Alexander V. Priezzhev, *Moscow State University*

Valery V. Tuchin, *Saratov State University*

Dmitry A. Zimnyakov, *Saratov State Technical University*

The main goal of the Workshop is

to introduce young researchers and students to the international community of scientists dealing with development and application of laser and optical technologies in medicine and biology. Joining this fast-developing field of research is impossible without active English, the language that has become an international communicative tool of modern science. The communicative problem that most of the beginner scientists face is well expressed in the maxim "If you want your voice to be heard in the present-day world, it should sound in English"

Most of the modern publications necessary for the work of a graduate student, postgraduate or young scientists is in English. Therefore, the skill of scanning large amounts of English text with selecting informationally valuable fragments will be one of the leading topics of the sessions and round-table discussions. The level of discussions will be intended for graduate students.

The main attention will be paid to training the active English as an international communicative tool without which it is impossible to present one's own research results to the scientific community. Traditionally in Russia the language education of specialists in natural sciences was oriented at passive English. We

believe that introducing the students and young researchers to the technology of scientific presentations and Internet sites, to the style and grammar peculiarities of a scientific article, etc., will stimulate the progress in their language education and help to overcome the psychological barrier impeding the active use of English.

The Workshop will include lecture sessions with oral presentations. The subjects touched upon during these sessions will be extended and developed in round-table discussions.

We expect active participation of the leading English instructors of Saratov National Research State University, including those working within the framework of REC006 Project, the School professors that have considerable experience in English scientific presentations, the members of Editorial Boards and referees of international journals. At least 3-4 foreign scientists including those from English-speaking countries are supposed to take part in the Workshop.

In the framework of the Workshop an Internet session will be organized in which the participants will be introduced to the facilities of remote language acquisition and consult with instructors.

Topics

The education program will include but is not restricted to the following topic

areas:

- The style of a modern scientific publication
- Cursory reading as a means to extract maximal information basing on minimal vocabulary
- Submitting a paper to an International Journal: language requirements
- Russian-English terminology system in biomedical optics

Workshop: **Management of High Technologies Commercialization and Regional Innovation Systems XVI**

Chairs

Julia S. Skibina, LLC SPE
"Nanostructured Glass Technology"

Andrey Shuvalov, LLC SPE
"Nanostructured Glass Technology"

Valery V. Tuchin, *Saratov State
University*

Secretary

Anastasiya A. Zanishevskaya,
LLC SPE "Nanostructured Glass
Technology"

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IPG Inc., USA

Robert Breault,
Breault Research Organization, Arizona
Optics Industry Association, USA

Leonid E. Dolotov, *Saratov State
University*

Yury V. Kistenev, Tomsk State
University, Russian Technology
Platform "The Medicine of the Future"

Boris Reznik, BioRASI, Inc., USA

Natalya V. Romanova, Saratov
State University

Sergey N. Sokolov,
RME "INJECT" LLC, Saratov, Russia

Stoyan Tanev,
University of Southern Denmark,
Denmark

Andreas Thoss, THOSS Media
GmbH, Berlin, Germany

The workshop program will include
the following **topics**:

- High technology commercialization, innovation management, high technologies and business, technologies of opening of the innovative companies, innovative business, transfer of technologies, financing of innovative activity, management of innovation risks, venture financing, education in the field of management in biophotonics and biotechnologies
- Development and monitoring of branch "road maps" as the basis for planning of regional branch clusters and innovation zones

- Actual priorities of the regional innovation policy
- Experience of IP commercialization and actual problems of Academy of Sciences, high schools, chambers of commerce and regional industrial company interaction

Workshop: **History, Methodology and Philosophy of the Optical EducationXII**

Co-chairs:

Boris A. Medvedev, Vladimir P. Ryabukho, Saratov State University

Secretary:

Alexander A. Skaptsov, Saratov State University

International Program Committee

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Boris A. Medvedev, Saratov State University

Vladimir P. Ryabukho, Saratov State University

Alexander V. Priezhev, M.V. Lomonosov Moscow State University

Alexander V. Gorokhov, Samara State University

Valery V. Tuchin, Saratov State University

Alex Vitkin, University of Toronto, Canada

The goals of the Workshop are the development of the optical education, the actualization of the interdisciplinary investigation using optical conceptions and tools, the expansion of European educational field of optical physics and biophysics and the increase of creative resources and potential of bachelor, master's degree, post-graduate training in Optics and Biophotonics.

Topics

There are three main discussing topics.

History of discoveries in optics:

- Founders of optical physics
- History of optical scientific schools
- Optical discoveries on chronicles of the world culture
- Historical aspects of optical investigations for life science

Methodology problems of the optical education:

- Lecture demonstrations of optics
- University optical training

- Methodology of teaching optics in the general course of physics at a natural-science department
- Principles of optical mathematical simulation

Teaching optics in the light of the interdisciplinary education and scientific knowledge integration:

- Problems of teaching optics at medical colleges and universities
- Optical physics in the course "The modern natural scientific conception" at humanitarian departments
- Minimum program of biology, biophysics, biochemistry, and biomedicine for student specialized in optics

SPIE Short Course:

Optical imaging systems to guide surgery and radiation therapy



Brian W Pogue

Thayer School of Engineering,
Dartmouth-Hitchcock Medical
Center, Hanover, USA

optical and x-ray radiation source technologies are the two central pillars for human medical imaging and therapy, and interventional guidance in treatment is guided by both of them. The strengths of x-rays are deep tissue penetration, effective cytotoxicity, and the ability to image with robust projection and computed-tomography methods. The major limitations of x-ray use are the lack of molecular specificity and the carcinogenic risk. In

comparison, optical interactions with tissue are strongly scatter dominated, leading to limited tissue penetration, making imaging and therapy largely restricted to superficial or endoscopically directed tissues. In comparison, optical photon energies are comparable with molecular energy levels, thereby providing the strength of intrinsic molecular specificity. Additionally, optical technologies are highly advanced and diversified, being ubiquitously used throughout medicine as the single largest technology sector.

This short course will review the roles of guidance and the technologies used to ensure that therapy is delivered accurately. The parts of course are:

- 1. Optics & X-rays in medicine – review of strengths, limitations and synergies
- 2. Optical surgical guidance in medicine – visualization, structures, perfusion, metabolism & immunology

- 3. Optical guidance in radiation therapy – positioning, surface maps, dosimetry, verification & quality audit

Learning objectives

This course will provide the technical participants with a basic understanding of the uses of x-rays and optical systems in medicine.

The course will provide expert research guidance on:

- surgical guidance systems and what is possible;
- molecular imaging capabilities and emerging molecular tracers for human use;
- radiotherapy techniques and technologies used;
- camera systems and spectroscopic techniques for sampling these signals;
- measurement tools for dose and molecular sensing.

Intended audience

Undergraduate, Masters, and PhD students, post-doctoral trainees and research scientists in physical sciences and engineering with an

interest in biomedical device translation.

Course level

Intermediate

Short Course duration

Half a day (two 1 hour lectures plus breaks)

Instructor

Brian W. Pogue, Ph.D. is the MacLean Professor of Engineering at Dartmouth in Hanover, New Hampshire USA, as well as Adjunct Professor of Surgery in the Geisel School of Medicine at Dartmouth. He has a Ph.D. in Medical/Nuclear Physics from McMaster University, in Canada, and was a research fellow at the Wellman Center for Photomedicine at the Massachusetts General Hospital, Harvard Medical School. At Dartmouth since 1996, he works in the area of Optics in Medicine, with a focus on novel imaging systems for characterizing cancer and tracking responses to therapy. He was Dean of Graduate Studies at Dartmouth from 2008-2012, and is now Director of MS and PhD Programs in Engineering Science & Medical Physics at Dartmouth. He

has published over 300 peer-reviewed papers and 400 conference papers in the areas of monitoring cancer therapy with optical signals, in surgery, medicine, medical oncology, and radiotherapy. His research is funded by the National Cancer Institute through a Program Project grant as well as several individual R01 grants and he co-directs a program project P01 grant. He is currently an editorial board member for Physics in Medicine & Biology, Medical Physics, and Breast Cancer Research, and is the Editor-in-Chief of the Journal of Biomedical Optics. He is an elected fellow of the Optical Society of America (OSA) and the American Institute of Medical and Biological Engineers (AIMBE). He recently founded the start up company DoseOptics LLC, making the world's first camera to image radiotherapy dose delivery as it happens.

OSA Short Course:

Functional optical imaging of developmental dynamics in vivo



Irina V. Larina

Baylor College of Medicine,
Houston, USA

Early development is a highly dynamic process dependent on multiple highly orchestrated regulatory mechanisms. Investigation of these mechanisms through advanced optical visualization and functional analysis provides valuable insight toward better management of congenital defects. This short course will describe optical

imaging approaches used to investigate various questions in developmental biology using mouse as a mammalian model organism. Live imaging methods, such as vital fluorescence, multiphoton, second harmonic generation (SHG), light-sheet microscopy, and functional optical coherence tomography for investigation of early embryonic morphogenesis will be presented. The lectures will highlight latest advances in developmental biology due to innovations in optical imaging as well as technological challenges for future investigations.

The short course will be subdivided into following parts:

1. Vital fluorescence microscopy for investigation of early development

The lecture will first introduce the principle of using vital fluorescence reporters under control of regulatory elements to

track cellular/subcellular dynamics and tissue development in vivo. An approach for live microscopic imaging of vital fluorescence reporters in static mouse embryo culture toward analysis of cardiovascular system will be presented. Advantages and limitations of confocal microscopy and light-sheet microscopy for embryonic cardiovascular imaging will be discussed.

2. Optical methods for biomechanical analysis of embryonic cardiodynamics

Optical coherence tomography allows for fast dynamic imaging of tissues at cellular resolution without application of contrast agents or fluorescent probes; however, traditional OCT technology does not allow to capture the dynamics of the beating heart volumetrically at a sufficient volume rate directly. Approaches for acquisition, synchronization, volumetric reconstruction, and dynamic analysis will be presented. Functional OCT methods, such as

Doppler blood flow measurement, speckle variance analysis of vasculature, and 4D angiography for blood flow segmentation in the beating heart, will be presented. SHG imaging of cardiac collagen will be demonstrated as an approach to investigate cardiac morphogenesis and maturity. The use of optogenetic stimulation for regulation of cardiodynamics and future challenges in biomechanical analysis will be presented.

3. Functional optical coherence tomography for investigation of reproductive processes

This part of the course will present an approach for dynamic imaging of reproductive events in vivo through an intravital dorsal imaging window using optical coherence tomography. Novel functional OCT methods for cilia and cilia beat frequency mapping and volumetric gamete tracking will be presented. Latest discoveries, future steps, and major technological challenges in optical imaging of reproductive processes in vivo will be

discussed.

Learning objectives

This course will provide the participants with:

basic understanding of using vital fluorescent reporters for live microscopic analysis;

basic knowledge of modern state-of-the-art imaging methods in developmental biology; understanding the principal, advantages, and limitations of these methods;

getting familiar with multiple functional OCT methods to characterize physiological processes through analysis of signal fluctuations;

basic knowledge of current biological questions and technological challenges, toward future progress of this exciting multidisciplinary research area.

Intended audience

Undergraduate, Master and PhD students, postdoctoral trainees, and research scientists in the areas of physics, engineering

and biomedicine.

Course level

Intermediate

Short Course duration

Half a day

Instructor

Dr. Irina V. Larina's research focuses on development of novel methods for intravital, optical imaging in mouse models to understand normal development and the nature of congenital defects and reproductive disorders in humans. Dr. Larina is an Associate Professor at the Department of Molecular Physiology and Biophysics and a co-Director of the Optical Imaging and Vital Microscopy Core at the Baylor College of Medicine, Houston, USA. Dr. She received Masters Degree in Physics from the Saratov State University, Russia, in 1996, PhD degree in Physiology and Biophysics and Bioengineering from the University of Texas Medical Branch at Galveston in 2005, and completed postdoctoral training at the Baylor

College of Medicine in Houston. She is a recipient of Arthur V. Simmang Academic Scholarship for Excellence in Academic Achievement, Ralph and Mary Spence Centennial Scholarship for Superior Academic Performance, High Personal and Professional Ethics, Values and Standards, Katherina Siebert Award for Excellence in Oncologic Research, Louis C. Sheppard Award, fellowship from the American Heart Association named in honor of Paula McCann-Harris, and a finalist for the Burrows Wellcome Fund Award at Scientific Interface. Dr. Larina is an author of over 50 peer-reviewed publications and 11 book chapters, and her research activities are funded by multiple grants from the National Institutes of Health.

Ryerson University Short Course:
Near-infrared Spectroscopy in
Cardiac Arrest and Cardiac
Surgery



Vladislav Toronov
Department of Physics, Ryerson
University, Toronto, Canada

In recent years there is an exponentially increasing interest to the near-infrared spectroscopy (NIRS) as the tool of brain monitoring during cardiac arrest and surgery. This lecture provides introduction into the multispectral and hyperspectral NIRS of tissue with the focus on the metabolic and perfusion brain imaging. It also explains the basic physiology of the cardiac arrest and hypoxic ischemic brain injury and how NIRS can monitor the key

physiological parameters of the brain. The analytical review of many recent studies is also provided in the clinical perspective.

Learning objectives

This course will provide the participants with:

- basic knowledge of NIRS methodology, Physics, and biomarkers;
- basic knowledge of hyperspectral and multispectral NIRS apparatus for brain measurements;
- state of the art of NIRS measurements of oxygen metabolism vs oxygen saturation;
- understanding the importance of NIRS brain monitoring.

Intended audience

- Master and PhD students, postdocs, scientists from various disciplines, e.g. physicists, biologists, chemists, engineers, biomedical scientists, and clinicians.

Course level

Intermediate
Short Course duration

Two hours

Instructor

Vlad Toronov received PhD in Physics from Saratov State University, Russia, in 1993. Was research scientist in Biomedical Physics in the University of Illinois at Urbana-Champaign (1997–2006). Currently Toronov is a faculty member in the Department of Physics, of Physics, Ryerson University, Toronto. Research interests include brain imaging and modelling, optical spectroscopy and imaging of tissue. Toronov is a member of iBEST Institute <https://www.ibestresearch.ca/>.