

PROGRESS IN BIOMEDICAL OPTICS AND IMAGING

Vol. 18 No. 31

# ***Optical Elastography and Tissue Biomechanics IV***

**Kirill V. Larin**  
**David D. Sampson**  
*Editors*

**28–30 January 2017**  
**San Francisco, California, United States**

*Sponsored by*  
SPIE

*Co-sponsored by*  
Thorlabs, Inc. (United States)

*Published by*  
SPIE

**Volume 10067**

Proceedings of SPIE, 1605-7422, V. 10067

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Optical Elastography and Tissue Biomechanics IV, edited by Kirill V. Larin, David D. Sampson, Proc. of SPIE Vol. 10067, 1006701 · © 2017 SPIE · CCC code: 1605-7422/17/\$18 · doi: 10.1117/12.2276738

Proc. of SPIE Vol. 10067 1006701-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at [SPIDigitalLibrary.org](http://SPIDigitalLibrary.org).

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *Optical Elastography and Tissue Biomechanics IV*, edited by Kirill V. Larin, David D. Sampson, Proceedings of SPIE Vol. 10067 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 1605-7422  
ISSN: 2410-9045 (electronic)

ISBN: 9781510605756  
ISBN: 9781510605763 (electronic)

Published by

**SPIE**

P.O. Box 10, Bellingham, Washington 98227-0010 USA  
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445  
[SPIE.org](http://SPIE.org)

Copyright © 2017, Society of Photo-Optical Instrumentation Engineers.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at [copyright.com](http://copyright.com). Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 1605-7422/17/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL  
LIBRARY**

[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

**Paper Numbering:** *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

# Contents

v	<i>Authors</i>
vii	<i>Conference Committee</i>

---

## KEYNOTE SESSION

---

10067 05	<b>Viscoelastic tissue characteristics measured by ultrasound (Keynote Paper) [10067-4]</b>
----------	---

---

## ELASTOGRAPHY METHODS AND APPLICATIONS: THE EYE

---

10067 0B	<b>Mapping in-vivo optic nerve head strains caused by intraocular and intracranial pressures (Invited Paper) [10067-11]</b>
10067 0D	<b>Quantifying the effects of UV-A/riboflavin crosslinking on the elastic anisotropy and hysteresis of the porcine cornea by noncontact optical coherence elastography [10067-13]</b>
10067 0E	<b>Fluorescence spectroscopy for non-invasive measurement of mechanical stiffness after photo-crosslinking of rabbit cornea [10067-14]</b>
10067 0F	<b>Assessing the changes in the spatial stiffness of the posterior sclera as a function of IOP with air-pulse OCE [10067-15]</b>

---

## BRILLOUIN ELASTOGRAPHY I

---

10067 0J	<b>What is next for Brillouin microscopy in biology and medicine? (Invited Paper) [10067-19]</b>
----------	--

---

## BRILLOUIN ELASTOGRAPHY II

---

10067 0K	<b>Using Brillouin microspectroscopy to characterize adipocytes' response to lipid droplet accumulation [10067-20]</b>
----------	--

---

## ELASTOGRAPHY METHODS AND APPLICATIONS III

---

10067 0V	<b>Multiparameter thermo-mechanical OCT-based characterization of laser-induced cornea reshaping [10067-31]</b>
----------	---

**CELLULAR BIOMECHANICS AND APPLICATIONS: JOINT SESSION WITH CONFERENCES 10067 AND 10074**

---

10067 0Y **Real-time and non-invasive measurements of cell mechanical behaviour with optical coherence phase microscopy** [10067-34]

**OPTICAL CLEARING AND BIOMECHANICS: JOINT SESSION WITH CONFERENCES 10063 AND 10067**

---

10067 10 **Observation of skull-guided acoustic waves in a water-immersed murine skull using optoacoustic excitation** [10067-36]

**POSTER SESSION**

---

10067 13 **Optimization of dental implantation** [10067-39]

10067 14 **Evaluation of dermal fillers with noncontact optical coherence elastography** [10067-40]

10067 18 **Optimal selection of laser modulation parameters in photothermal optical coherence tomography** [10067-44]

10067 19 **Automated fiber tracking and tissue characterization of the anterior cruciate ligament with optical coherence tomography** [10067-45]

10067 1A **Assessing the viscoelasticity of chicken liver by OCE and a Rayleigh wave model** [10067-46]

# Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Aglyamov, Salavat R., 0D, 0F, 14, 1A  
Alizad, A., 05  
Bagnaninchi, P. O., 0Y  
Balasubramanian, Priya S., 19  
Ballmann, Charles W., 0J  
Baum, Olga I., 0V  
Coker, Zachary, 0J, 0K  
Dol, Aleksandr V., 13  
Downes, A., 0Y  
El Haj, A., 0Y  
Estrada, Héctor, 10  
Franco, Walfre, 0E  
Gamal, W., 0Y  
Gelikonov, Grigory V., 0V  
Gillies, D., 0Y  
Gogola, A., 0B  
Greenleaf, J. F., 05  
Grimm, J., 0B  
Guo, Jiaqi, 19  
Gupta, Ashish, 18  
Han, Zhaolong, 0D, 0F, 14, 1A  
Hendon, Christine P., 19  
Ivanov, Dmitriy V., 13  
Lafon, Ericka, 0F  
Larin, Kirill V., 0D, 0F, 14, 1A  
Lewis, William, 0E  
Li, Jiasong, 0D  
Liu, Chih-Hao, 0D, 1A  
Lu, Helen H., 19  
Matveev, Lev A., 0V  
Matveyev, Alexandr L., 0V  
Meng, Zhaokai, 0J  
Nair, Achuth, 0D, 0F  
Nelson, S., 0B  
Omelchenko, Alexander I., 0V  
Ortega-Martinez, Antonio, 0E  
Qu, Dovina, 19  
Raghunathan, Raksha, 0D, 1A  
Razansky, Daniel, 10  
Rebling, Johannes, 10  
Reinwald, Y., 0Y  
Schuman, J., 0B  
Shabanov, Dmitry V., 0V  
Sigal, I. A., 0B  
Singh, Manmohan, 0D, 0F, 14, 1A  
Smith, M. A., 0B  
Sobol, Emil N., 0V  
Sovetsky, Alexander A., 0V  
Tabatabaei, Nima, 18  
Tran, H., 0B  
Traverso, Andrew, 0K  
Troyanova-Wood, Maria, 0J, 0K  
Twa, Michael D., 0D  
Tyler-Kabara, E., 0B  
Villiger, Martin, 18  
Vitkin, Alex, 0V  
Wang, B., 0B  
Wang, Shang, 14  
Williams, Maura, 0E  
Wollstein, G., 0B  
Wu, Chen, 0F, 1A  
Yakovlev, Vladislav V., 0J, 0K  
Yang, Y., 0Y  
Yao, Xinwen, 19  
Yee, Richard W., 14  
Zaitsev, Vladimir Yu., 0V



# Conference Committee

## *Symposium Chairs*

**James G. Fujimoto**, Massachusetts Institute of Technology  
(United States)

**R. Rox Anderson**, Wellman Center for Photomedicine, Massachusetts  
General Hospital (United States) and Harvard School of Medicine  
(United States)

## *Program Track Chair*

**Steven L. Jacques**, Oregon Health & Science University  
(United States)

## *Conference Chairs*

**Kirill V. Larin**, University of Houston (United States)

**David D. Sampson**, The University of Western Australia (Australia)

## *Conference Program Committee*

**Jeffrey C. Bamber**, Institute of Cancer Research (United Kingdom)

**Stephen A. Boppart**, University of Illinois at Urbana-Champaign  
(United States)

**Brett E. Bouma**, Wellman Center for Photomedicine (United States)

**Zhongping Chen**, Beckman Laser Institute and Medical Clinic  
(United States)

**Kishan Dholakia**, University of St. Andrews (United Kingdom)

**Daniel S. Elson**, Imperial College London (United Kingdom)

**Brendan F. Kennedy**, The University of Western Australia (Australia)

**Sean J. Kirkpatrick**, Michigan Technological University (United States)

**Matthew O'Donnell**, University of Washington (United States)

**Amy L. Oldenburg**, The University of North Carolina at Chapel Hill  
(United States)

**Gabriel Popescu**, University of Illinois at Urbana-Champaign  
(United States)

**Jannick P. Rolland**, University of Rochester (United States)

**Giuliano Scarcelli**, University of Maryland, College Park  
(United States)

**Gijs van Soest**, Erasmus MC (Netherlands)

**Peter Török**, Imperial College London (United Kingdom)

**Ruikang K. Wang**, University of Washington (United States)

**Seok Hyun A. Yun**, Wellman Center for Photomedicine (United States)

**Vladimir Y. Zaitsev**, Russian Academy of Science Nizhny Novgorod  
(Russian Federation)  
**Qifa Zhou**, The University of Southern California (United States)

*Session Chairs*

- 1 Novel Methods and Devices  
**Kirill V. Larin**, University of Houston (United States)  
**David D. Sampson**, The University of Western Australia (Australia)
- 2 Keynote Session  
**David D. Sampson**, The University of Western Australia (Australia)  
**Kirill V. Larin**, University of Houston (United States)
- 3 Elastography Methods and Applications I  
**Giuliano Scarcelli**, University of Maryland, College Park  
(United States)  
**Gabriel Popescu**, University of Illinois at Urbana-Champaign  
(United States)
- 4 Tissue Mechanical Contrast  
**Amy L. Oldenburg**, The University of North Carolina at Chapel Hill  
(United States)
- 5 Elastography Methods and Applications: The Eye  
**Brett E. Bouma**, Wellman Center for Photomedicine (United States)  
**Ruikang K. Wang**, University of Washington (United States)  
**Seok-Hyun Yun**, Wellman Center for Photomedicine (United States)
- 6 Brillouin Elastography I  
**Zhongping Chen**, Beckman Laser Institute and Medical Clinic  
(United States)  
**Peter Török**, Imperial College London (United Kingdom)  
**Qifa Zhou**, The University of Southern California (United States)
- 7 Brillouin Elastography II  
**Brendan F. Kennedy**, The University of Western Australia (Australia)  
**Jannick P. Rolland**, University of Rochester (United States)
- 8 Elastography Methods and Applications II  
**Daniel S. Elson**, Imperial College London (United Kingdom)  
**Sean J. Kirkpatrick**, Michigan Technological University (United States)
- 9 Elastography Methods and Applications III  
**Matthew O'Donnell**, University of Washington (United States)  
**Vladimir Y. Zaitsev**, Russian Academy of Science Nizhny Novgorod  
(Russian Federation)



- 10 Cellular Biomechanics and Applications: Joint Session with Conferences 10067 and 10074  
**Kirill V. Larin**, University of Houston (United States)  
**YongKeun Park**, KAIST (Korea, Republic of)  
**Gabriel Popescu**, University of Illinois at Urbana-Champaign (United States)  
**David D. Sampson**, The University of Western Australia (Australia)
- 11 Optical Clearing and Biomechanics: Joint Session with Conferences 10063 and 10067  
**Kirill V. Larin**, University of Houston (United States)  
**Martin J. Leahy**, National University of Ireland, Galway (Ireland)  
**David D. Sampson**, The University of Western Australia (Australia)  
**Valery V. Tuchin**, N.G. Chernyshevsky Saratov National Research State University (Russian Federation), National Research Tomsk State University (Russian Federation), and Institute of Precision Mechanics and Control RAS (Russian Federation)

