

PROCEEDINGS OF SPIE

# ***Ultrafast Nonlinear Imaging and Spectroscopy VI***

**Zhiwen Liu**  
**Demetri Psaltis**  
**Kebin Shi**  
*Editors*

**19–20 August 2018**  
**San Diego, California, United States**

*Sponsored and Published by SPIE*

**Volume 10753**

Proceedings of SPIE 0277-786X, V. 10753

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

Ultrafast Nonlinear Imaging and Spectroscopy VI, edited by Zhiwen Liu, Demetri Psaltis, Kebin Shi, Proc. of SPIE Vol. 10753, 1075301 · © 2018 SPIE · CCC code: 0277-786X/18/\$18 · doi: 10.1117/12.2514602

Proc. of SPIE Vol. 10753 1075301-1

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 *Ultrafast Nonlinear Imaging and Spectroscopy VI*, edited by Zhiwen Liu, Demetri Psaltis, Kebin Shi, Proceedings of SPIE Vol. 10753 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

ISSN: 0277-786X  
ISSN: 1996-756X (electronic)

ISBN: 9781510620773  
ISBN: 9781510620780 (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 © 2018, 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 0277-786X/18/\$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> |

---

## ADVANCED IMAGING TECHNOLOGIES I

---

|          |                                                                                                                                  |
|----------|----------------------------------------------------------------------------------------------------------------------------------|
| 10753 0F | <b>Tomographic imaging with harmonic holography in tissues of known refractive index distribution (Invited Paper)</b> [10753-13] |
|----------|----------------------------------------------------------------------------------------------------------------------------------|

---

## ADVANCED IMAGING TECHNOLOGIES II

---

|          |                                                                                              |
|----------|----------------------------------------------------------------------------------------------|
| 10753 0I | <b>Mid-infrared photothermal spectroscopy with phase analysis (Invited Paper)</b> [10753-17] |
|----------|----------------------------------------------------------------------------------------------|

---

## ULTRAFAST ELECTRON IMAGING

---

|          |                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------|
| 10753 0R | <b>Attomicroscopy: attosecond electron microscopy (Invited Paper)</b> [10753-26]                                |
| 10753 0S | <b>High-coherence relativistic electron probes for ultrafast structural dynamics (Invited Paper)</b> [10753-27] |

---

## BIOLOGICAL APPLICATIONS

---

|          |                                                                                                                                                                       |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10753 10 | <b>Resonance Raman imagery of semi-fossilized soft tissues (Invited Paper)</b> [10753-35]                                                                             |
| 10753 12 | <b>Critical setup parameter for ultrafast whitelight coherent antistokes raman scattering spectroscopy of living plankton in sea water (Invited Paper)</b> [10753-37] |
| 10753 13 | <b>Low cost laser induced breakdown spectroscopy technique for detection of microorganisms</b> [10753-38]                                                             |

---

## POSTER SESSION

---

|          |                                                                                                               |
|----------|---------------------------------------------------------------------------------------------------------------|
| 10753 14 | <b>In vivo NIR Raman and autofluorescence spectroscopies of skin neoplasms</b> [10753-39]                     |
| 10753 17 | <b>Experimental study of Kerr effect and nonlinear absorption of multi walled carbon nanotubes</b> [10753-42] |



## 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.

Acuna Herrera, Rodrigo, 17  
Artemyev, Dmitry N., 14  
Bratchenko, Ivan A., 14  
Broderick, Neil G.R., 12  
Centurion, M., 0S  
Durham, D. B., 0S  
Filippetto, D., 0S  
Griffin, B., 0S  
Hallen, Hans, 10  
Hassan, M. Th., 0R  
Isaza M., Cesar A., 17  
J. Vasa, Nilesh, 13  
Ji, F., 0S  
Kaganov, Oleg I., 14  
Khristoforova, Yulia A., 14  
Kozlov, Sergey V., 14  
Long, Brandon, 10  
Minor, A., 0S  
Moryatov, Alexander A., 14  
Musumeci, P., 0S  
Myakinin, Oleg O., 14  
Orlov, Andrey E., 14  
Psaltis, Demetri, 0F  
Pu, Ye, 0F  
Riminucci, F., 0S  
Risos, Alex, 12  
Samolis, Panagis, 0I  
Sander, Michelle Y., 0I  
Schweitzer, Mary, 10  
Simpson, M. Cather, 12  
Sivakumar, Vivek, 13  
Slaughter, D., 0S  
Srikanth, Padma, 13  
Unni, Sujatha N., 13  
vergara Palacio, Sebastian, 17  
Wang, X., 0S  
Williams, David E., 12  
Zakharov, Valery P., 14  
Zheng, Wenxia, 10



# Conference Committee

## *Program Track Chair*

**Ruyan Guo**, The University of Texas at San Antonio (United States)

## *Conference Chairs*

**Zhiwen Liu**, The Pennsylvania State University (United States)

**Demetri Psaltis**, Ecole Polytechnique Fédérale de Lausanne  
(Switzerland)

**Kebin Shi**, Peking University (China)

## *Conference Program Committee*

**George Barbastathis**, Massachusetts Institute of Technology  
(United States)

**Randy A. Bartels**, Colorado State University (United States)

**Martin Centurion**, University of Nebraska-Lincoln (United States)

**Jason M. Eichenholz**, Open Photonics, Inc. (United States)

**Kenan Gundogdu**, North Carolina State University (United States)

**Hans D. Hallen**, North Carolina State University (United States)

**Iam Choon Khoo**, The Pennsylvania State University (United States)

**Zhenyu Li**, The George Washington University (United States)

**Fiorenzo Gabriele Omenetto**, Tufts University (United States)

**Michelle Y. Sander**, Boston University (United States)

**Jigang Wang**, Iowa State University of Science and Technology  
(United States)

**Yong Xu**, Virginia Polytechnic Institute and State University  
(United States)

## *Session Chairs*

- 1 Ultrafast Nanoscale Imaging and Spectroscopy I  
**Kebin Shi**, Peking University (China)
- 2 Ultrafast Nanoscale Imaging and Spectroscopy II  
**Kenan Gundogdu**, North Carolina State University (United States)
- 3 Advanced Imaging Technologies I  
**William T. Murray**, The Pennsylvania State University (United States)
- 4 Advanced Imaging Technologies II  
**Ye Pu**, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

- 5 SFG/SHG  
**Cheng-Yu Wang**, The Pennsylvania State University (United States)
- 6 Ultrafast Electron Imaging  
**Chuanshan Tian**, Fudan University (China)
- 7 Ultrafast Laser Processing  
**Michelle Y. Sander**, Boston University (United States)
- 8 Ultrafast Sources and Applications  
**Brandon J.N. Long**, North Carolina State University (United States)
- 9 Biological Applications  
**Zhiwen Liu**, The Pennsylvania State University (United States)