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Topics in biomedical optics: introduction

Jeremy C. Hebden, David A. Boas, John S. George, and Anthony J. Durkin

The field of biomedical optics is experiencing tremendous growth. Biomedical technologies contribute in the creation of devices used in healthcare of various specialties (ophthalmology, cardiology, anesthesiology, and immunology, etc.). Recent research in biomedical optics is discussed. Overviews of meetings held at the 2002 Optical Society of America Biomedical Topical Meetings are presented. © 2003 Optical Society of America

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1. Introduction

Biomedical optics technologies continue to advance at a spectacular rate, contributing to the growth of novel devices that affect healthcare in virtually all medical specialties: ophthalmology, dermatology, oncology, radiology, anesthesiology, gynecology, neurosurgery, gastroenterology, cardiology, cardiothoracic surgery, neonatology, immunology, and clinical chemistry. Few basic biological science disciplines are not touched by biomedical optics, since optical methods now play a critical role in biotechnologies ranging from genomics to cell-based assays. In view of this, the importance of biomedical optics has never been greater.

This issue of *Applied Optics* highlights recent research in biomedical optics. This particular issue was proposed by *Applied Optics* Associate Editor Gregory Faris (SRI International) with the idea of featuring research presented at the 2002 Optical Society of America Biomedical Topical Meetings in which such topics as advances in optical imaging and photon migration; biomedical optical spectroscopy, imaging, and diagnostics; and optical techniques in neuroscience were discussed.

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Currently held every other year, the Biomedical Optics Topical Meeting brings together basic scientists, engineers, and physicians who are engaged in research using optical methods in biology and medicine. The program for the 2002 meeting was held from Sunday, 7 April through Wednesday, 10 April 2002 at the Fontainebleau Hilton Resort and Towers in Miami, Florida. The General Chairs of the 2002 Biomedical Topical Meeting, Arjun Yodh (University of Pennsylvania) and Bruce J. Tromberg (Beckman Laser Institute) organized an extremely successful meeting and were able to engage the financial support of the United States Air Force, the United States Department of Energy and the following corporations: Xenogen, Infraredx, NIRx, Xillix and SpectRx. These monies were directed at assisting graduate students and postdoctoral fellows to defray expenses related to attending the meeting.

This meeting attracted 317 attendees, including the leading experts in the field. The scientific program consisted of 135 contributed oral presentations, 22 invited presentations, and 71 poster presentations. Multiple poster sessions allowed for lively discussions about the latest research. The 2002 Biomedical Optics Meeting brought together three key meetings in the field:

Advances in Optical Imaging and Photon Migration. This meeting is intended as a primary forum for researchers from this diverse community to present and discuss the latest developments in optical imaging techniques for medical diagnostics and the recent progress in the study of photon migration in human tissue. Topics covered new and evolving methods and instrumentation, theoretical and numerical modeling, and a broad range of clinical applications.

Biomedical Optical Spectroscopy, Imaging, and Diagnostics. The wealth of biochemical and structural

information contained in optical signatures remitted from tissues offers new frontiers in the engineering of biomedical spectroscopy and diagnostics. Developments in fluorescence, phosphorescence, Raman scattering, elastic scattering, reflectance, and nonlinear spectroscopies in tissues continue to fuel advances in diagnostic capability. Recent advances include progress in blood gas and blood constituent monitoring, *in situ* spectroscopic optical biopsy for disease detection and characterization, and novel methods of optical histopathology utilizing confocal, nonlinear, and near-field scanning microscopy. The objective and scope of this topical meeting has been to highlight these and other frontiers of biomedical optical engineering that are directed toward new screening and diagnostic procedures in the clinic, and through joint sessions with the Advances in Optical Imaging and Photon Migration meeting, to explore the applications of multispectral imaging to cells and tissues.

Optical Techniques in Neuroscience. The emphasis of this meeting has been on state-of-the-art optical techniques in neuroscience. The crossfertilization of neuroscientists, optical scientists, engineers, physicists, and mathematicians has created an exciting educational atmosphere, stimulating discussion about new research directions and collaborations. Presentations encompassed optical investigations of brain physiology or function on scales ranging from dendritic spines to the whole brain and on temporal scales from submillisecond to seconds.

In addition to the contributed scientific program, three special events were introduced to the Biomedical Optics meetings:

Advances in Neuroscience. This event, co-chaired by David A. Boas (Massachusetts General Hospital) and John George (Los Alamos National Laboratories) featured keynote presentations by Amiram Grinvald (IBM; Thomas J. Watson Research Center; and Weizmann Institute of Science, Israel), and Britton Chance (University of Pennsylvania). These keynote presentations were followed by presentations from panel members Ron Frostig (University of

California-Irvine), Lawrence Cohen (Yale University), and Arno Villringer (Charite Hospital, Germany).

A View from NIH's Newest Institute: Opportunities and Challenges. This event was organized by Irene Georgakoudi (MIT) and included a presentation by Donna Dean, Acting Director of the National Institute for Biomedical Imaging and Bioengineering, who provided attendees with her perspectives on the affect of the National Institute for Biomedical Imaging and Bioengineering on biomedical optics and bioengineering. The presentation served as the basis for fruitful discussions and interactions between junior researchers and their peers in industry and academia.

Industry Roll-Out. This special symposium, organized by Shabbir Bambot, Director of Advanced Technologies, SpectRx Inc., and Anthony Durkin (Beckman Laser Institute) provided a forum during which scientists from premier biomedical optics-oriented companies each made a presentation followed by a question and answer session. Participants included Infraredx, Xillix, Xenogen, SpectRx and NIRx. This forum provided an important focal point to the conference, stimulating interaction and discussion among attendees from academia, industry, and medicine throughout the meeting.

2. Conclusion

With the convergent capabilities of molecular techniques and optical technologies, we are in a position to use light for probing and manipulating biological processes with unprecedented precision and control. This ability, in turn, provides us with new opportunities to generate fundamental information, solve important biological problems, and develop the next generation of medical techniques. The biomedical optics topical meetings are a primary source for reporting these discoveries in detail. Our expectation is that attendance to the biomedical optics meetings will continue to increase, and we anticipate that the 2004 Biomedical Optics Topical Meeting will be a great success.