
**Antonello Cutolo**
**Brian Culshaw**
**José Miguel López-Higuera**
*Editors*

**4–6 July 2007**
**Napoli, Italy**

**Organized by**
Optoelectronic Division – Engineering Department, Università degli Studi del Sannio (Italy)

**Technical Cosponsors**
SPIE Europe
SIOF—Societa Italiana di Ottica e fotonica
EOS—European Optical Society

**Published by**
SPIE

SPIE Volume 6619

The papers included 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. The papers published in these proceedings 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 this book:
Author(s), "Title of Paper," in *Third European Workshop on Optical Fibre Sensors*, edited by Antonello Cutolo, Brian Culshaw, José Miguel López-Higuera, Proceedings of SPIE Vol. 6619 (SPIE, Bellingham, WA, 2007) Article CID Number.

ISSN 0277-786X
ISBN 9780819467614

Published by
**SPIE—The International Society for Optical Engineering**
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone 1 360/676-3290 (Pacific Time) · Fax 1 360/647-1445
http://www.spie.org



Printed in the United States of America.

# Contents




**Pagination:** Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication.

SPIE uses a six-digit CID article numbering system in which:
• The first four 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. The complete citation is used on the first page, and an abbreviated version on subsequent pages.

## INVITED TALKS



## SPECIAL PAPER

*Wednesday, 4 July 2007*

**SESSION I PHYSICAL AND MECHANICAL SENSORS**

*Thursday Morning, 5 July 2007*

**SESSION II CHEMICAL, ENVIRONMENTAL, BIOMECHANICAL, AND MEDICAL SENSORS**

*Thursday Afternoon, 5 July 2007*

**SESSION III ELECTROMAGNETIC, INTERFEROMETRIC, POLARIMETRIC, NEW CONCEPTS, AND DEVICES FOR SENSORS**

661934 **Hollow-core optical fiber functionalized with single walled carbon nanotubes for VOC detection**
M. Pisco, M. Consales, Univ. of Sannio (Italy); S. Campopiano, Univ. of Naples Parthenope (Italy); P. Aversa, M. Penza, ENEA, Ctr. Ricerche Brindisi (Italy); M. Giordano, Institute of Composite and Biomedical Materials, CNR (Italy); A. Cutolo, A. Cusano, Univ. of Sannio (Italy)

661935 **Optical properties of photonic crystal fibers with the strain**
J. M. Lázaro, C. Galindez, A. Quintela, A. Cobo, J. M. López-Higuera, Univ. of Cantabria (Spain)

661936 **Low-contrast photonic bandgap fibers and their potential applications in liquid-base sensors**
H. Xuan, The Hong Kong Polytechnic Univ. (Hong Kong China) and Tsinghua Univ. (China); W. Jin, J. Ju, H. L. Ho, The Hong Kong Polytechnic Univ. (Hong Kong China); M. Zhang, Tsinghua Univ. (China); Y. Liao, The Hong Kong Polytechnic Univ. (Hong Kong China) and Tsinghua Univ. (China)

661937 **How to play with the spectral sensitivity of interferometers using slow light concepts — and how to do it practically**
M. Gonzalez-Herraez, O. Esteban, F. B. Naranjo, Univ. of Alcalá (Spain); L. Thevenaz, École Polytechnique Fédérale de Lausanne (Switzerland)

*Friday, 6 July 2007*

**SESSION IV DISTRIBUTED, MULTIPLEXING, SYSTEM APPLICATIONS, AND FIELD TRIALS**

661938 **High performance Brillouin distributed fibre sensor**
S. Diaz, Public Univ. of Navarra (Spain); S. Foaleng Mafang, École Polytechnique Fédérale de Lausanne (Switzerland); M. Lopez-Amo, Public Univ. of Navarra (Spain); L. Thévenaz, École Polytechnique Fédérale de Lausanne (Switzerland)

661939 **Distributed fiber optic sensing for traffic monitoring purposes**
M. Hlaváč, Slovak Univ. of Technology (Slovak Republic)

66193A **Pulse shapes effects on backscattering Brillouin gain for distributed fiber sensing**
C. Galíndez, J. M. Lázaro, P. B. García-Allende, F. Madruga, J. M. López-Higuera, Univ. de Cantabria (Spain)

66193B **High performance and highly reliable Raman-based distributed temperature sensors based on correlation-coded OTDR and multimode graded-index fibers**
M. A. Soto, Scuola Superiore Sant'Anna (Italy); P. K. Sahu, Indian Institute of Technology (India); S. Faralli, Scuola Superiore Sant'Anna (Italy); G. Sacchi, Photonic Networks National Lab. (Italy); G. Bolognini, F. Di Pasquale, Scuola Superiore Sant'Anna (Italy); B. Nebendahl, C. Rueck, Agilent Technologies Research and Development and Marketing GmbH & Co. KG (Germany)

66193C **Raman-based distributed temperature sensing supported by integrated-optics technology**
G. Cattaneo, R. Belli, P. Boffi, S. Avanzi, F. Persia, A. Melloni, M. Martinelli, Politecnico di Milano (Italy)

# Conference Committees

*General Chair*

**Antonello Cutolo,** Università degli Studi del Sannio (Italy)

*Technical Program Chairs*

**Brian Culshaw,** University of Strathclyde (United Kingdom)
**José Miguel López-Higuera,** Universidad de Cantabria (Spain)

*Technical Program Committee*

**M. Armenise**, Politecnico di Bari (Italy)
**F. Baldini**, Institute of Applied Physics–CNR (Italy)
**I. Bennion**, Aston University (United Kingdom)
**A. Bjarklev**, Technical University of Denmark (Denmark)
**T. Bosselmann**, Siemens AG (Germany)
**A. Cobo García**, University of Cantabria (Spain)
**J. P. Dakin**, University of Southampton (United Kingdom)
**P. Ferdinand**, CEA LIST (France)
**K. T. V. Grattan**, City University (United Kingdom)
**D. Inaudi**, SMARTEC SA (Switzerland)
**S. James**, Cranfield University (United Kingdom)
**L. R. Jaroszewicz**, Military University of Technology (Poland)
**J. D. C. Jones**, Heriot–Watt University (United Kingdom)
**M. Martinelli**, University of Milano (Italy)
**A. G. Mignani**, Institute of Applied Physics–CNR (Italy)
**G. Orellana**, Madrid Complutense Universidad (Spain)
**D. Pagnoux**, University of Limoges (France)
**J. Rayss**, Marie Curie–Sklodowska University (Poland)
**G. Righini**, IFAC–CNR (Italy)
**J. L. C. de Oliveira Santos**, University of Porto (Portugal)
**M. Lopez-Amo Sainz**, Public University of Navarra (Spain)
**G. Stewart**, University of Strathclyde (United Kingdom)
**L. Thévenaz**, Swiss Federal Institute of Technology (Switzerland)
**H. Thienpont**, Vrije Universiteit Brussel (Belgium)
**M. Tur**, Tel Aviv University (Israel)
**M. Voet**, FOS&S (Belgium)
**R. Willsch**, Institute for Physical High–Technology (Germany)

*International Advisory Committee*

**W. J. Bock**, Université du Québec en Outaouais (Canada)
**R. O. Claus**, Virginia Tech. (USA)
**F. Farahi**, University of North Carolina at Charlotte (USA)

**M. Haruna**, University of Osaka (Japan)
**K. Hotate**, University of Tokyo (Japan)
**W. Jin**, The Hong Kong Polytechnic University (China)
**H. José Kalinowski**, Federal University of Technology (Brazil)
**B. Y. Kim**, Korea Advanced Institute of Science and Technology (South Korea)
**S. Bae Lee**, Korea Institute of Science and Technology (South Korea)
**F. Mendoza**, Centro de Investigaciones en Optica (Mexico)
**D. D. Sampson**, University of Western Australia (Australia)
**W. B. Spillman, Jr.**, Columbia Gorge Research (USA)
**F. Svelto**, ASI (Italia Spatial Agency) (Italy)
**P. Swarz**, University of Johannesburg (South Africa)

*Technical Local Organising Committee*

**G. Breglio**, University of Naples Federico II (Italy)
**S. Campopiano**, University of Naples Phartenope (Italy)
**A. Crescitelli**, University of Sannio (Italy)
**A. Cusano**, University of Sannio (Italy)
**M. Giordano**, IMCB–CNR (Italy)
**A. Iadicicco**, University of Naples Phartenope (Italy)

*Administrative Local Organising Committee*

**P. Ambrosino**, University of Sannio (Italy)
**A. Saioni**, Effe Erre Congressi s.r.l. (Italy)

# Introduction

Welcome to Napoli and to the third in our consolidated series on optical fibre sensors.

We have the honour of organizing this workshop after the successful past editions (Peebles 1998, Santander 2004). Much has changed, especially considering the enormous impact of nanotechnology, although much has also stayed the same. Bragg gratings continue to excite the research and industrial community, and distributed sensors offer enormous potential in several industrial sectors. Biological and chemical areas are emerging with new demands, opening new application opportunities in life science. New concepts based on photonic crystal fibres, band-gap structures, active and functionalised materials at sub-wavelength or nano-scale, and metamaterials offer a potential that has yet to be realised. The areas in which fibre sensors are applied continue to steadily expand, and most certainly commercial activity has significantly increased.

The organization of the workshop will be devoted to create a colloquial and informal atmosphere in order to help knowledge exchange and the creation of new collaborations. Our goal is to provide a common forum for leading international authorities, young researchers, practitioners, user-communities, and research planners. The aim is to stimulate and convey considerations, thoughts, and future perspectives on the role of optical fibre sensor technology in the wider sensing world.

To this aim, the workshop program includes invited oral contributions given by leading authorities, and submitted contributions principally in poster form with discussions groups. We have also incorporated a special session: Optical Fibre Sensors: Market Opportunities. In this session, leading authorities from the industrial world will provide a market overview of optical fibre sensors in important industrial sectors. You will also hear of important aspects related to optical fibre-based systems' commercialization such as reliability and standards.

These proceedings include 149 papers. Fifteen are from very well reputed world-wide invited speakers. One is a special paper and 133 were accepted after being peer reviewed for their significance, innovation, and quality by well recognised experts in the field.

On behalf of all involved in the preparation of the conference, we would like to particularly thank Andrea Cusano, Agostino Iadicicco, and Alessio Crescitelli for the technical support, and Paola Ambrosino and Alessandra Saioni for the administrative assistance.

Our sponsors, listed within these proceedings, have donated both financial and technical support for which we are extremely grateful. The technical and advisory committee reviewed the papers with skill, authority, and speed, providing invaluable technical and strategic inputs to the conference program.

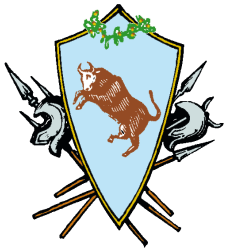
It is a great pleasure to welcome you to southern Italy. This is a very beautiful part of the country and we hope that in addition to participating in what we expect to be a very stimulating meeting, you will have the opportunity to explore this amazing area.

**Antonello Cutolo**
**Brian Culshaw**
**José Miguel López-Higuera**

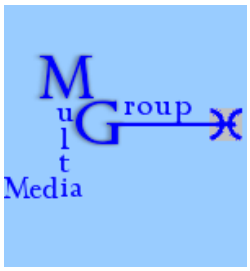
# Conference Sponsors

## Organizer


## Sponsors

**Provincia di Benevento**





## Technical Cosponsors

## Cooperating Cosponsors

**Istituto**
**per i Materiali**
**Compositi e Biomedici**


**Seconda Università degli studi di Napoli**

**Istituto per il Rilevamento Elettromagnetico dell'Ambiente**


**Università degli Studi di Napoli Parthenope**

**Università degli Studi di Napoli Federico II**