Complexity and Nonlinear Dynamics

Axel Bender
Chair/Editor

12–13 December 2006
Adelaide, Australia

Sponsored and Published by
SPIE—The International Society for Optical Engineering

Cosponsored by
Australian Government Department of Defence, Defence Science and Technology Organisation (Australia)
Office of Naval Research through the Global Office of Naval Research Science and Technology (USA)
Air Force Office of Scientific Research through the Asian Office of Aerospace Research and Development (USA and Japan)
COSNet-ARC Complex Open Systems Research Network (Australia)
Australian Research Council Nanotechnology Network (Australia)

Volume 6417

The International Society for Optical Engineering

SPIE is an international technical society dedicated to advancing engineering and scientific applications of optical, photonic, imaging, electronic, and optoelectronic technologies.
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.

**Disclaimer:** The support provided for the conference by the co-sponsors is not intended as an endorsement of the contents of anything in these proceedings. Specifically, DSTO support is not intended to express or imply endorsement by the Australian Commonwealth Government; AFOSR/AOARD support is not intended to express or imply endorsement by the U.S. Federal Government; ONR Global support is not intended to express or imply endorsement by the U.S. Federal Government; COSNet support is not intended to express or imply endorsement by the Australian Research Council (ARC) or the Australian Commonwealth Government; ARC Nanotech Network support is not intended to express or imply endorsement by the Australian Research Council (ARC) or the Australian Commonwealth Government.

Please use the following format to cite material from this book:


ISSN 0277-786X
ISBN 9780819465252

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

Copyright © 2007, The 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 $15.00 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 http://www.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/07/$15.00.

Printed in the United States of America.
Contents

v Conference Committee
vii Introduction
ix Symposium Sponsors

SESSION 1 NONLINEARITY IN DEVICE APPLICATIONS AND MANUFACTURING PROCESSES

641702 Electric field detectors in a coupled ring configuration: preliminary results (Invited Paper) [6417-01]
B. Ando, S. Baglio, F. Di Grande, F. Passaniti, N. Savalli, Univ. degli Studi di Catania (Italy); V. In, A. R. Bulsara, Space and Naval Warfare Systems Ctr., San Diego (USA)

641704 Nonlinear dynamics that appear in the dynamical model of drying process of a polymer solution coated on a flat substrate [6417-04]
H. Kagami, Nagoya College (Japan)

SESSION 2 DISORDER, IMBALANCE, AND NONEQUILIBRIUM

641706 High-resolution optimal quantization for stochastic pooling networks (Invited Paper) [6417-08]
M. D. McDonnell, The Univ. of Adelaide (Australia); P.-O. Amblard, Lab. des Images et des Signaux, CNRS (France); N. G. Stocks, The Univ. of Warwick (United Kingdom); S. Zozor, Lab. des Images et des Signaux, CNRS (France); D. Abbott, The Univ. of Adelaide (Australia)

641707 Relaxation in complex systems and fractional calculus [6417-09]
V. E. Arkhincheev, Federal Urdu Univ. of Arts, Science, and Technologies (Pakistan) and Buryat Science Ctr. (Russia); A. B. Bainova, Buryat State Univ. (Russia)

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, 20-22, 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.
SESSION 3 EXPLORING AND EXPLOITING NOISE

641708 Brownian motion in tilted periodic potential driven by green impulse noise [6417-10]
S. A. Guz, M. G. Nikulin, M. V. Sviridov, Moscow Institute of Physics and Technology (Russia)

64170B Simulation and measurement of a two-stage complex network model [6417-16]
H. Luo, K. Horadam, RMIT Univ. (Australia)

SESSION 4 BIO- AND SOCIO-SYSTEM DYNAMICS

64170C Fractal transformations of harmonic functions (Invited Paper) [6417-13]
M. F. Barnsley, U. Freiberg, The Australian National Univ. (Australia)

64170D Marital infidelity and its effect on pathogen diversity [6417-14]
M. J. Berryman, The Univ. of Adelaide (Australia)

SESSION 5 THE COMPLEX HUMAN BODY

64170F Quantitative modeling of multiscale neural activity (Invited Paper) [6417-19]
P. A. Robinson, Univ. of Sydney (Australia) and Westmead Millenium Institute (Australia);
C. J. Rennie, Univ. of Sydney (Australia), Westmead Millenium Institute (Australia), and
Westmead Hospital (Australia)

64170G 1/f dynamics adaptable attractor selection and synchronizability in noise-driven multistable
neuronal networks [6417-20]
L. A. Safonov, The Univ. of Tokyo (Japan) and Japan Society for the Promotion of Science
(Japan); Y. Yamamoto, Japan Society for the Promotion of Science (Japan)

Author Index
Conference Committee

Symposium Chairs

Joe G. Shapter, Flinders University of South Australia (Australia)
Vijay K. Varadan, University of Arkansas (USA)
Derek Abbott, University of Adelaide (Australia)

Conference Chair

Axel Bender, Defence Science and Technology Organisation (Australia)

Conference Cochairs

Hussein A. Abbass, University of New South Wales (Australia)
Derek Abbott, The University of Adelaide (Australia)
Adi R. Bulsara, Space and Naval Warfare Systems Command, San Diego (USA)

Program Committee

Tomaso Aste, The Australian National University (Australia)
Salvatore Baglio, Università degli Studi di Catania (Italy)
Rowena Ball, The Australian National University (Australia)
Michael F. Barnsley, The Australian National University (Australia)
Matthew J. Berryman, The University of Adelaide (Australia)
Julyan H. E. Cartwright, Universidad de Granada (Spain)
Tiziana Di Matteo, The Australian National University (Australia)
J. Doyne Farmer, Santa Fe Institute (USA)
Peter Hall, The Australian National University (Australia)
Brian Hanlon, Defence Science and Technology Organisation (Australia)
Plamen C. H. Ivanov, Boston University (USA)
Geoff James, Commonwealth Scientific and Industrial Research Organisation (Australia)
Neil F. Johnson, University of Oxford (United Kingdom)
Michael K. Lauren, Defence Technology Agency (New Zealand)
Peter A. Lindsay, The University of Queensland (Australia)
Raj Mohanty, Boston University (USA)
Alexander B. Neiman, Ohio University (USA)
Mario Nicodemi, Università degli Studi di Napoli Federico II (Italy)
Wouter-Jan Rappel, University of California, San Diego (USA)
Peter A. Robinson, The University of Sydney (Australia)
Alex Ryan, Defence Science and Technology Organisation (Australia)
Yoshiharu Yamamoto, The University of Tokyo (Japan)
Session Chairs

1. Nonlinearity in Device Applications and Manufacturing Processes
   Adi R. Bulsara, Space and Naval Warfare Systems Command, San Diego (USA)

2. Disorder, Imbalance, and Nonequilibrium
   Matthew J. Berryman, The University of Adelaide (Australia)

3. Exploring and Exploiting Noise
   Michael F. Barnsley, The Australian National University (Australia)

4. Bio- and Socio-System Dynamics
   Derek Abbott, The University of Adelaide (Australia)

5. The Complex Human Body
   Axel Bender, Defence Science and Technology Organisation (Australia)
Introduction

In these Proceedings a number of papers are presented that were submitted to and featured during the Complexity and Nonlinear Dynamics Conference of the SPIE International Symposium on Smart Materials, Nano- and Micro-Smart Systems in Adelaide, 12–13 December 2006. All contributions were peer-reviewed and accepted by a technical committee of complex systems scientists.

Researchers came from around the world, including the United States of America, Japan, Russia, Italy, and all parts of Australia to participate in and contribute to the second Australian complexity science related conference under the umbrella of the International Society for Optical Engineering (SPIE). While small in attendance, it was an exciting event that provided an effective forum for multi-disciplinary exchange across many fields of science, technology and engineering. Most natural systems are “on the edge of chaos” – between order and randomness. Complexity, as governed by non-linear dynamics, can be observed everywhere. It therefore comes as no surprise that many scientific and engineering disciplines deal with complex system phenomena and characteristics such as self-organisation, emergence, adaptation, non-linear feed-forward and feedback, stochastic resonance or swarm and herd behaviours. These proceedings are a fine compendium of work addressing two of the biggest challenges of scientists and engineers today: the understanding and taking advantage of complexity and the underlying nonlinear dynamic processes.

I would like to express my gratitude to the three conference cochairs Hussein A. Abbass (UNSW@ADFA, Australia), Univ. of New South Wales (Australia), Derek Abbott, (Univ. Adelaide, Australia) and Adi R. Bulsara (Space and Naval Warfare Systems Command, USA), without whose expert advice this conference wouldn’t have been possible. My thanks also go to the members of the Program Committee each of whom contributed significantly to the success of this second SPIE Complex Systems Conference in Australia: Tomaso Aste (ANU, Australia), Salvatore Baglio (Univ. Catania, Italy), Rowena Ball, Michael F. Barnsley (ANU, Australia), Matthew J. Berryman (Univ. Adelaide, Australia), Julyan H. E. Cartwright (Univ. Granada, Spain), Tiziana Di Matteo (ANU, Australia), J. Doyne Farmer (Santa Fe Institute, USA), Peter Hall (ANU, Australia), Brian Hanlon (DSTO, Australia), Plamen C. H. Ivanov (Boston Univ., USA), Geoff James (CSIRO, Australia), Neil F. Johnson (Univ. Oxford, UK), Michael K. Lauren (DTA, New Zealand), Peter A. Lindsay (Univ. Queensland, Australia), Raj Mohanty (Boston Univ., USA), Alexander B. Neiman (Ohio Univ., USA), Mario Nicodemi (Univ. Napoli Federico II, Italy), Wouter-Jan Rappel (Univ. California/San Diego, USA), Peter A. Robinson (Univ. Sydney, Australia), Alex Ryan (DSTO, Australia), Yoshiharu Yamamoto (Univ. Tokyo, Japan).
Last but not least I wish to acknowledge the efforts of the enthusiastic teams of the SPIE Technical Program Department and SPIE Proceedings Editors, who worked hard to get the programme up and running and ensured that the manuscripts meet high standards.

Axel Bender
We wish to thank the co-sponsors for their contribution to the success of the conference:

Defence Science and Technology Organisation (DSTO)
Air Force Office of Scientific Research, Asian Office of Aerospace Research and Development
Office of Naval Research Global
ARC Complex Open Systems Research Network
ARC Nanotechnology Network