

Discontinuity, Nonlinearity, and Complexity

Editors

Valentin Afraimovich

San Luis Potosi University, IICO-UASLP, Av.Karakorum 1470
Lomas 4a Seccion, San Luis Potosi, SLP 78210, Mexico
Fax: +52 444 825 0198
Email: valentin@cactus.iico.uaslp.mx

Lev Ostrovsky

Zel Technologies/NOAA ESRL, Boulder CO 80305, USA
Fax: +1 303 497 5862
Email: Lev.A.Ostrovsky@noaa.gov

Xavier Leoncini

Centre de Physique Théorique, Aix-Marseille Université, CPT
Campus de Luminy, Case 907
13288 Marseille Cedex 9, France
Fax: +33 4 91 26 95 53
Email: leoncini@cpt.univ-mrs.fr

Dimitry Volchenkov

The Center of Excellence Cognitive Interaction Technology
Universität Bielefeld, Mathematische Physik Universitätsstraße
25 D-33615 Bielefeld, Germany
Fax: +49 521 106 6455
Email: volchenk@physik.uni-bielefeld.de

Associate Editors

Marat Akhmet

Department of Mathematics
Middle East Technical University
06531 Ankara, Turkey
Fax: +90 312 210 2972
Email: marat@metu.edu.tr

Ranis N. Ibragimov

Applied Statistics Lab
GE Global Research
1 Research Circle, K1-4A64
Niskayuna, NY 12309
Email: ibrranis@gmail.com

Jose Antonio Tenreiro Machado

ISEP-Institute of Engineering of Porto
Dept. of Electrotechnical Engineering
Rua Dr. Antonio Bernardino de Almeida
4200-072 Porto, Portugal
Fax: +351 22 8321159
Email: jtm@dee.issep.ipp.pt

Dumitru Baleanu

Department of Mathematics and Computer
Sciences
Cankaya University, Balgat
06530 Ankara, Turkey
Email: dumitru@cankaya.edu.tr

Nikolai A. Kudryashov

Department of Applied Mathematics
Moscow Engineering and Physics Institute
(State University), 31 Kashirskoe Shosse
115409 Moscow, Russia
Fax: +7 495 324 11 81
Email: kudryashov@mephi.ru

Denis Makarov

Pacific Oceanological Institute of the
Russian Academy of Sciences,43
Baltiiskaya St., 690041 Vladivostok,
RUSSIA
Tel/fax: 007-4232-312602.
Email: makarov@poi.dvo.ru

Marian Gidea

Department of Mathematics
Northeastern Illinois University
Chicago, IL 60625, USA
Fax: +1 773 442 5770
Email: mgidea@neiu.edu

Gennady A. Leonov

Department of Mathematics and Mechanics
St-Petersburg State University
198504, Russia
Email: leonov@math.spbu.ru

Josep J. Masdemont

Department of Matematica Aplicada I
Universitat Politècnica de Catalunya
(UPC) Diagonal 647 ETSEIB
08028 Barcelona, Spain
Email: Josep@barquins.upc.edu

Juan Luis García Guirao

Department of Applied Mathematics
Technical University of Cartagena
Hospital de Marina 30203-Cartagena,
SPAIN
Fax: +34 968 325694
E-mail: juan.garcia@upct.es

E.N. Macau

Lab. Associado de Computação e Matemática
Aplicada, Instituto Nacional de Pesquisas
Espaciais, Av. dos Astronautas, 1758
12227-010 São José dos Campos –SP Brazil
Email: elbert@lac.inpe.br

Michael A. Zaks

Technische Universität Berlin
DFG-Forschungszentrum Matheon -
Mathematics for key technologies
Sekretariat MA 3-1, Straße des 17. Juni
136
10623 Berlin
Email: zaks@physik.hu-berlin.de

Editorial Board

Vadim S. Anishchenko

Department of Physics
Saratov State University
Astrakhanskaya 83, 410026, Saratov, Russia
Fax: (845-2)-51-4549
Email: wadim@info.sgu.ru

Mokhtar Adda-Bedia

Laboratoire de Physique Statistique
Ecole Normale Supérieure
24 rue Lhomond, 75231 Paris Cedex 05
France
Fax: +33 1 44 32 34 33
Email: adda@lps.ens.fr

Ravi P. Agarwal

Department of Mathematics
Texas A&M University – Kingsville,
Kingsville, TX 78363-8202
USA
Email: agarwal@tamuk.edu

An Interdisciplinary Journal of
**Discontinuity,
Nonlinearity,
and Complexity**

Volume 4, Issue 2, June 2015

Editors
Valentin Afraimovich
Xavier Leoncini
Lev Ostrovsky
Dimitry Volchenkov



L&H Scientific Publishing, LLC, USA

Publication Information

Discontinuity, Nonlinearity, and Complexity (ISSN 2164-6376 (print), eISSN 2164-6414 (online)) is published quarterly (March, June, September, and December) by L & H Scientific Publishing, LLC, P.O. Box 99, Glen Carbon, IL62034, USA. Subscription prices are available upon request from the publisher or from this journal website. Subscriptions are accepted on a prepaid basis only and entered on a calendar year basis. Issues are sent by standard mail (Surface in North America, air delivery outside North America). Priority rates are available upon request. Claims for missing issues should be made within six months of the date of dispatch.

Changes of Address

Send address changes to L&H Scientific Publishing, LLC, P.O. Box 99, Glen Carbon, IL62034, USA. Changes of address must be received at L&H Scientific Publishing eight weeks before they are effective.

Authors Inquiries

For inquiries relative to the submission including electronic submission where available, please visit journal website or contact journal Editors-in-Chief.

Advertising Information

If you are interested in advertising or other commercial opportunities, please email via lhscientificpublishing@gmail.com and your enquiry will be handled as soon as possible.

© 2015 L&H Scientific Publishing, LLC. All rights reserved

L&H Scientific Publishing, LLC requires the authors to sign a Journal Copyright Transfer Agreement for all articles published in L&H Scientific. The Copyright Transfer Agreement is an agreement under which the author retains copyright in the work but grants L & H Scientific Publishing LLC the sole and exclusive right and license to publish the full legal term of copyright.

Authors are responsible for obtaining permission from copyright holders for reproducing any illustrations, tables, figures or lengthy quotations published somewhere previously.

For authorization to photocopy materials for internal or personal use under those circumstances not falling within the fair use provisions of Copyright Act, requests for reprints and translations should be addressed to the permission office of L&H Scientific publishing, LLC via lhscientificpublishing@gmail.com or call: 1-618-402-2267. Permission of the Publisher and payment of a fee are required for all other photocopying, including multiple or systematic copying, copying for advertising or promotional purposes, resale, and forms of document delivery. Special rates are available for educational institutions to make photocopies for non-profit educational classroom use.

Subscribers may reproduce tables of contents or prepare lists of articles including abstracts for internal circulation within their institutions. Permission of the publisher is required for resale or distribution outside the institution.

Permission of the Publisher is required to store or use electronically any materials contained in this journal, including any entire or partial article, please contact the publisher for advice. Otherwise, no part of this publication can be reproduced, stored in a retrieval systems or transmitted in any form or by means, electronic, mechanical, photocopying, recording or without prior written permission of the Publisher.

Disclaimer

The authors, editors and publisher will not accept any legal responsibility for any errors or omissions that may be made in this publication. The publisher makes no warranty, express or implied, with respect to the material contained herein.

Printed in USA on acid-free paper.

Aims and Scope

The interdisciplinary journal publishes original and new results on recent developments, discoveries and progresses on Discontinuity, Nonlinearity and Complexity in physical and social sciences. The aim of the journal is to stimulate more research interest for exploration of discontinuity, complexity, nonlinearity and chaos in complex systems. The manuscripts in dynamical systems with nonlinearity and chaos are solicited, which includes mathematical theories and methods, physical principles and laws, and computational techniques. The journal provides a place to researchers for the rapid exchange of ideas and techniques in discontinuity, complexity, nonlinearity and chaos in physical and social sciences. Topics of interest include but not limited to

- Complex and hybrid dynamical systems
- Discontinuous dynamical systems (i.e., impulsive, time-delay, flow barriers)
- Nonlinear discrete systems and symbolic dynamics
- Fractional dynamical systems and control
- Stochastic dynamical systems and randomness
- Complexity, self-similarity and synchronization
- Complex nonlinear phenomena in physical systems
- Stability, bifurcation and chaos in complex systems
- Turbulence and other complex phenomena in hydrodynamics
- Nonlinear waves and solitons
- Dynamical networks
- Combinatorial aspects of dynamical systems
- Biological dynamics and biophysics
- Pattern formation, social science and complexization

No length limitations for contributions are set, but only concisely written manuscripts are published. Brief papers are published on the basis of Technical Notes. Discussions of previous published papers are welcome.

Peer Review

Discontinuity, Nonlinearity, and Complexity adopts the traditional blind-review policy in which the reviewers' names are concealed for submission author(s) for free submission. Each submitted manuscript is reviewed at least two referees in appropriate fields. In addition, the editorial board members' recommendation or established experts' recommendation publication are welcome.

Manuscript Submission Guidelines

For manuscript submission, authors can directly contact Editors-in-Chief. Manuscript preparation can follow the sample papers and journal manuscript templates (word file and Latex files), which can be found from the website at <https://lmscientificpublishing.com/Journals/DNC-Default.aspx>

Proofs and Electronic Offprints

Authors will receive a PDF proof of their articles and, on publication, electronic offprints of the article.

Open Access

After manuscripts were accepted, author(s) have a right to request the accepted manuscripts published by L&H Scientific publishing with open access, and the author(s) have a responsibility to paying the open access publication fee with US\$30 per page. The copyright is still held by the Publisher. Without any request of the open access publication, the accepted manuscripts are assumed to be published traditionally.

Igor Belykh

Department of Mathematics & Statistics
Georgia State University
30 Pryor Street, Atlanta, GA 30303-3083
USA
Email: ibelykh@gsu.edu

Didier Bénisti

CEA, DAM, DIF 91297 Arpajon Cedex
France
Fax: +33 169 267 106
Email: didier.benisti@cea.fr

Alexandre N. Carvalho

Departamento de Matemática, Instituto de
Ciências Matemáticas e de Computação
Universidade de São Paulo - Campus de
São Carlos, Caixa Postal 668, 13560-970
São Carlos SP, Brazil
Email: andcarva@icmc.usp.br

Maurice Courbage

CNRS-UMR 7057 "Matière et Systèmes
Complexes", 75205 Paris Cedex 13 France
Email: maurice.courbage@univ-paris-diderot.fr

Michal Feckan

Department of Mathematical Analysis and
Numerical Mathematics, Comenius
University Mlynska dolina
842 48 Bratislava, Slovakia
Fax: +421 2 654 12 305
Email: michal.feckan@fmph.uniba.sk

Marie-Christine Firpo

Laboratoire de Physique des Plasmas
CNRS UMR 7648, Ecole Polytechnique
91128 Palaiseau cedex, France
Tel: (00 33) 1 69 33 59 04 Fax: (00 33) 1
69 33 59 06
E-mail:
marie-christine.firpo@lpp.polytechnique.fr

Stefano Galatolo

Dipartimento di Matematica Applicata
Via Buonattoti 1
56127 Pisa, Italy
Email: s.galatolo@ing.unipi.it

N.H. Ibragimov

Department of Mathematics, IHN
Blekinge Institute of Technology
S-371 79 Karlskrona, Sweden
Fax: +46 455 385 407
Email: nail.ibragimov@bth.se

Tassilo Küpper

Mathematical Institute
University of Cologne, Weyertal 86-90
D-50931 Cologne, Germany
Fax: +49 221 470 5021
Email: kuepper@math.uni-koeln.de

Marc Leonetti

IRPHE, Aix-Marseille Université
UMR CNRS 6594, Technopôle de Château-
Gombert 13384 Marseilles Cedex 13 France
Fax: + 33 4 13 55 20 01
Email: leonetti@irphe.univ-mrs.fr

Yuri Maistrenko

Institute of Mathematics
National Academy of Sciences of Ukraine
Volodymyrska Str. 54, room 232
01030 Kiev, Ukraine
E-mail: y.maistrenko@biomed.kiev.ua

Mikhail Malkin

Department of Mathematics and Mechanics
Nizhny Novgorod State University, Nizhny
Novgorod, Russia
Fax: +7 831 465 76 01
Email: malkin@unn.ru

Vladimir I. Nekorkin

Institute of Applied Physics of RAS
46 Ulyanov Street, 603950, Nizhny
Novgorod, Russia
Email: vnekorkin@neuron.appl.sci-nnov.ru

Dmitry E. Pelinovsky

Department of Mathematics & Statistics
McMaster University, 1280 Main Street
West, Hamilton, Ontario, Canada L8S 4K1
Fax: +1 905 522 0935
Email: dmpeli@math.mcmaster.ca

Alexander N. Pisarchik

Centro de Investigaciones en Optica
A.C. Loma del Bosque #115
Lomas del Campestre
37150 Leon Guanajuato, Mexico
Fax: +52 477 441 4209
Email: apisarch@cio.mx

Raul Rechtman

Centro de Investigacion en Energia
Universidad Nacional Autonoma de Mexico
Priv. Xochicalco S/N, Temixco
Morelos 62580, Mexico
Fax: +52 555 622 9791
Email: rrs@cie.unam.mx

Nikolai Rulkov

BioCircuits Institute, University of
California, San Diego, 9500 Gilman Drive
#0328 La Jolla, CA 92093-0328, USA
Fax: (858) 534-1892
Email: nrulkov@ucsd.edu

Andrey Shilnikov

Department of Mathematics and Statistics
Georgia State University, 100 Piedmont
Ave SE Atlanta GA 30303, USA
Fax: +1 404 413 6403
Email: ashilnikov@gsu.edu

Vasily E. Tarasov

Skobel'syn Institute of Nuclear Physics
Moscow State University
119992 Moscow, Russia
Fax: +7 495 939 03 97
Email: tarasov@theory.sinp.msu.ru

Marco Thiel

Institute for Mathematical Biology and
Complex Systems
University of Aberdeen
AB243UE Aberdeen, Scotland, UK
Fax: +44 1224 273105
Email: m.thiel@abdn.ac.uk

Vladimir V. Uchaikin

Ulyanovsk State University
L.Tolstoy Str. 42
Ulyanovsk 432700, Russia
Fax: +7 842 232 90 14
Email: vuchaikin@gmail.com

Edgardo Ugalde

Instituto de Fisica
Universidad Autonoma de San Luis Potosi
Av. Manuel Nava 6, Zona Universitaria
San Luis Potosi SLP
CP 78290, Mexico
Email: gallo.ugalde@gmail.com

Alexei A. Vasiliev

Space Research Institute
Profsoyuznaya 84/32
Moscow 117997, Russia
Fax: +7 495 333 12 48
Email: valex@iki.rssi.ru

Todd Young

Department of Mathematics
Ohio University
Athens, OH 45701, USA
Email: young@math.ohiou.edu