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

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: <u>leoncini@cpt.univ-mrs.fr</u>

Associate Editors

Marat Akhmet

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

Dumitru Baleanu

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

Marian Gidea

Department of Mathematical Sciences Yeshiva University New York, NY 10016, USA Fax: +1 212 340 7788 Email: <u>Marian.Gidea@yu.edu</u>

Juan Luis García Guirao

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

Ranis N. Ibragimov

Department of Mathematics and Physics University of Wisconsin-Parkside 900 Wood Rd, Kenosha, WI 53144 Tel: 1(262) 595-2517 Email: Ibragimo@uwp.edu

Alexander N. Pisarchik

Center for Biomedical Technology Technical University of Madrid Campus Montegancedo 28223 Pozuelo de Alarcon, Madrid, Spain E-mail: alexander.pisarchik@ctb.upm.es

Gennady A. Leonov

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

Elbert E.N. Macau

Laboratory for Applied Mathematics and Computing, National Institute for Space Research, Av. dos Astronautas, 1758 C. Postal 515 12227-010 - Sao Jose dos Campos - SP, Brazil Email: elbert.macau@inpe.br, <u>elbert.macau@gmail.com</u>

Lev Ostrovsky

University of Colorado, Boulder, and University of North Carolina, Chapel Hill, USA Email: lev.ostrovsky@gmail.com

Dimitri Volchenkov

Mathematics & Statistics, Texas Tech University, 1108 Memorial Circle, Lubbock, TX 79409, USA & Sichuan University of Science and Engineering, Sichuan, Zigong 643000, China Email: <u>dr.volchenkov@gmail.com</u>

J. A. Tenreiro Machado

Institute of Engineering, Polytechnic of Porto, Dept. of Electrical Engineering, Rua Dr. Antonio Bernardino de Almeida, 431, 4249-015 Porto, Portugal Fax: 351-22-8321159 Email: jtm@isep.ipp.pt

Josep J. Masdemont

Department of Mathematics. Universitat Politecnica de Catalunya. Diagonal 647 (ETSEIB,UPC) Email: josep.masdemont@yupc.edu

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

Michael A. Zaks

Institut für Physik Humboldt Universität Berlin Newtonstr. 15, 12489 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 Ecole Normale Supérieure de Lyon 46 Allée d'Italie, 69007 Lyon, France Email: adda@lps.ens.fr

Ravi P. Agarwal

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

An Interdisciplinary Journal of

Discontinuity, Nonlinearity, and Complexity

Volume 7, Issue 2, June 2018

Editors Valentin Afraimovich Xavier Leoncini Lev Ostrovsky Dimitry Volchenkov



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 adverting or other commercial opportunities, please email via lhscientificpublishing@gmail.com and your enquiry will be handled as soon as possible.

© 2018 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 lhscientific publishing@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://lhscientificpublishing.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\$60 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.

Continued from inside front cover

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-parisdiderot.fr

Michal Fečkan

Department of Mathematical Analysis and Numerical Mathematics, Comenius University in Bratislava, 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 Fax: (00 33) 1 69 33 59 06 Email: <u>marie-</u> <u>christine.firpo@lpp.polytechnique.fr</u>

Stefano Galatolo

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

N.H. Ibragimov

Director of Research Center "ALGA", Department of Mathematics and Natural Sciences, Blekinge Institute of Technology Karlskrona 371 79, Sweden, 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 7342, Technopôle de Château-Gombert 13384 Marseilles Cedex 13 France, Fax: + 33 4 13 55 20 01 Email: leonetti@irphe.univ-mrs.fr

Mikhail Malkin

Institute of Information Technologies, Mathematics and Mechanics, Lobachevsky State University of Nizhny Novgorod, Russia Fax: +7 831 465 76 01 Email: <u>malkin@unn.ru</u>

Vladimir I. Nekorkin

Institute of Applied Physics of RAS 46 Ul'yanov 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

Dmitry V. Kovalevsky,

Climate Service Center Germany (GERICS), Hamburg & Nansen International Environmental and Remote Sensing Centre (NIERSC) & Saint Petersburg State University (SPbU), St. Petersburg, Russia Email: <u>dmitry.v.kovalevsky@gmail.com</u>

Raul Rechtman

Instituto de Energias Renovables Universidad Nacional Autonoma de Mexico Priv. Xochicalco S/N, Temixco Morelos 65280 Mexico Fax: +52 555 622 9791 Email: <u>rrs@ier.unam.mx</u>

Andrey Shilnikov

Department of Mathematics & Statistics Georgia State University 100 Piedmont Ave Atlanta GA 30303 Tel: 404.413.6423 E-mail: <u>ashilnikov@gsu.edu</u>

Yury Stepanyants

University of Southern Queensland West St., Toowoomba, QLD, 4350 Australia Emails: yuas50@gmail.com, Yury.Stepanyants@usq.edu.au

Vasily E. Tarasov

Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University 119991 Moscow, Russia Fax: +7 495 939 03 97 Email: <u>tarasov@theory.sinp.msu.ru</u>

Vladimir V. Uchaikin

Ulyanovsk State University L.Tolstoy Str. 42 Ulyanovsk 432700, Russia Fax: +7 842 241 20 88 Email: vuchaikin@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

Ling Zhao

DCM-FFCLRP-USP Av. Bandeirantes, 3900 Bairro Monte Alegre, Ribeirao Preto – SP CEP 14040-901, Brazil Fax: 55-16-33150407 Email: <u>zhao@usp.br</u>