



# Static & Dynamic Game Theory: Foundations & Applications

*Series Editor*

Tamer Başar, University of Illinois, Urbana-Champaign, IL, USA

*Editorial Advisory Board*

Daron Acemoglu, MIT, Cambridge, MA, USA

Pierre Bernhard, INRIA, Sophia-Antipolis, France

Maurizio Falcone, Università degli Studi di Roma “La Sapienza,” Italy

Alexander Kurzhanski, University of California, Berkeley, CA, USA

Ariel Rubinstein, Tel Aviv University, Ramat Aviv, Israel; New York University, NY, USA

William H. Sandholm, University of Wisconsin, Madison, WI, USA

Yoav Shoham, Stanford University, CA, USA

Georges Zaccour, GERAD, HEC Montréal, Canada

More information about this series at <http://www.springer.com/series/10200>

Leon A. Petrosyan • Vladimir V. Mazalov  
Editors

# Recent Advances in Game Theory and Applications

European Meeting on Game Theory,  
Saint Petersburg, Russia, 2015, and  
Networking Games and Management,  
Petrozavodsk, Russia, 2015

*Editors*

Leon A. Petrosyan  
Department of Applied Mathematics  
and Control Processes  
Saint Petersburg State University  
Saint Petersburg, Russia

Vladimir V. Mazalov  
Institute of Applied Mathematical Research  
Karelia Research Center of Russian  
Academy of Sciences  
Petrozavodsk, Russia

ISSN 2363-8516                      ISSN 2363-8524 (electronic)  
Static & Dynamic Game Theory: Foundations & Applications  
ISBN 978-3-319-43837-5              ISBN 978-3-319-43838-2 (eBook)  
DOI 10.1007/978-3-319-43838-2

Library of Congress Control Number: 2016952093

Mathematics Subject Classification (2010): 91A

© Springer International Publishing Switzerland 2016

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

This book is published under the trade name Birkhäuser, [www.birkhauser-science.com](http://www.birkhauser-science.com)

The registered company is Springer International Publishing AG

The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

# Preface

The importance of strategic behavior in the human and social world is increasingly recognized in theory and practice. As a result, game theory has emerged as a fundamental instrument in pure and applied research. The discipline of game theory studies decision-making in an interactive environment. It draws on mathematics, statistics, operations research, engineering, biology, economics, political science, and other subjects. In canonical form, a game takes place when an individual pursues an objective in a situation in which other individuals concurrently pursue other (possibly overlapping, possibly conflicting) objectives, and at the same time, these objectives cannot be reached by the individual actions of one decision-maker. The problem then is to determine each object's optimal decisions, how these decisions interact to produce an equilibrium, and the properties of such outcomes. The foundation of game theory was laid more than 70 years ago by John von Neumann and Oskar Morgenstern. Theoretical research and applications are proceeding apace, in areas ranging from aircraft and missile control to inventory management, market development, natural resources extraction, competition policy, negotiation techniques, macroeconomic and environmental planning, capital accumulation, and investment. In all these areas, game theory is perhaps the most sophisticated and fertile paradigm applied mathematics can offer to study and analyze decision-making under real-world conditions.

It is necessary to mention that in 2000, Federico Valenciano organized GAMES 2000, the first meeting of the Game Theory Society in Bilbao. During this conference, Fioravante Patrone took the initiative of setting up a "joint venture" between Italy and Spain, suggesting meetings be held alternately in the said countries. The agreement on this idea led to the meetings in Ischia (2001), Seville (2002), Urbino (2003), and Elche (2004). During the meeting in Urbino, the Netherlands asked to join the Italian-Spanish alternating agreement, and so SING (Spanish-Italian-Netherlands Game Theory Meeting) was set up. The first Dutch edition was organized by Hans Peters in Maastricht from the 24th to 26th of June 2005. It was then agreed that other European countries wishing to enter the team had to participate first as guest organizers and only after a second participation in this role could they then actually join SING. As a result, the following countries acted as

guest organizers: Poland in 2008 (Wrocław, organized by Jacek Mercik), France in 2011 (Paris, Michel Grabisch), and Hungary in 2012 (Budapest, László Kóczy). Poland was the guest organizer for the second time in 2014 (Kraków, Izabella Stach) and became an actual member of SING. The 2015 edition took place in St. Petersburg.

Parallel to this activity, every year starting from 2007 at St. Petersburg State University (Russia), an international conference “Game Theory and Management (GTM)” and, at Karelian Research Centre of Russian Academy of Sciences in Petrozavodsk, a satellite international workshop “Networking Games and Management” took place. In the past years, among plenary speakers of the conference were Nobel Prize winners Robert Aumann, John Nash, Reinhard Selten, Roger Myerson, Finn Kydland, and many other world famous game theorists.

In 2014 in Krakow, the agreement was reached to organize the joint SING-GTM conference at St. Petersburg State University, and this meeting was named “European Meeting on Game Theory, SING11-GTM2015.”

Papers presented at the “European Meeting on Game Theory, SING11-GTM2015” and the satellite international workshop “Networking Games and Management” certainly reflect both the maturity and the vitality of modern-day game theory and management science in general and of dynamic games in particular. The maturity can be seen from the sophistication of the theorems, proofs, methods, and numerical algorithms contained in most of the papers in this volume. The vitality is manifested by the range of new ideas, new applications, and the growing number of young researchers and wide coverage of research centers and institutes from where this volume originated.

The presented volume demonstrates that “SING11-GTM2015” and the satellite international workshop “Networking Games and Management” offer an interactive program on a wide range of latest developments in game theory. It includes recent advances in topics with high future potential and existing developments in classical fields.

St. Petersburg, Russia  
Petrozavodsk, Russia  
March 2016

Leon Petrosyan  
Vladimir Mazalov

# Acknowledgments

The decision to publish a special proceedings volume was made during the closing session of “European Conference on Game Theory SING11-GTM2015,” and the selection process of the presented volume started in autumn of 2015.

The “European Conference on Game Theory SING11-GTM2015” was sponsored by St. Petersburg State University (Russia), and the satellite international workshop on “Networking Games and Management” was sponsored by the Karelian Research Centre of Russian Academy of Sciences.

Our thanks to the referees of the papers. Without their effective contribution, this volume would not have been possible.

We thank Anna Tur from St. Petersburg State University (faculty of Applied Mathematics) for demonstrating extreme patience by typesetting the manuscript.

# Contents

<b>Ranking Journals in Sociology, Education, and Public Administration by Social Choice Theory Methods</b> .....	1
Fuad T. Aleskerov, Anna M. Boriskova, Vladimir V. Pislyakov, and Vyacheslav I. Yakuba	
<b>On the Position Value for Special Classes of Networks</b> .....	29
Giulia Cesari and Margherita Maria Ferrari	
<b>A Differential Game of a Duopoly with Network Externalities</b> .....	49
Mario Alberto García-Meza and José Daniel López-Barrientos	
<b>The Shapley Value as a Sustainable Cooperative Solution in Differential Games of Three Players</b> .....	67
Ekaterina Gromova	
<b>Impact of Propagation Information in the Model of Tax Audit</b> .....	91
Elena Gubar, Suriya Kumacheva, Ekaterina Zhitkova, and Olga Porokhnyavaya	
<b>An Infinite Horizon Differential Game of Optimal CLV-Based Strategies with Non-atomic Firms</b> .....	111
Gerasimos Lianos and Igor Sloev	
<b>A Dynamic Model of a Decision Making Body Where the Power of Veto Can Be Invoked</b> .....	131
Jacek Mercik and David M. Ramsey	
<b>The Selten–Szidarovszky Technique: The Transformation Part</b> .....	147
Pierre von Mouche	
<b>Generalized Nucleoli and Generalized Bargaining Sets for Games with Restricted Cooperation</b> .....	165
Natalia Naumova	



<b>Occurrence of Deception Under the Oversight of a Regulator Having Reputation Concerns</b> .....	185
Ayça Özdoğan	
<b>Bayesian Networks and Games of Deterrence</b> .....	201
Michel Rudnianski, Utsav Sadana, and Hélène Bestougeff	
<b>A New Look at the Study of Solutions for Games in Partition Function Form</b> .....	225
Joss Sánchez-Pérez	
<b>A Model of Tacit Collusion: Nash-2 Equilibrium Concept</b> .....	251
Marina Sandomirskaja	
<b>Strong Coalitional Structure in an Open Vehicle Routing Game</b> .....	271
Nikolay Zenkevich and Andrey Zyatchin	

# Contributors

**Fuad T. Aleskerov** National Research University Higher School of Economics, Moscow, Russia

Institute of Control Sciences of Russian Academy of Science, Moscow, Russia

**Hélène Bestougeff** CODATA France, Paris, France

**Anna M. Boriskova** International Laboratory of Decision Choice and Analysis, National Research University Higher School of Economics, Moscow, Russia

**Giulia Cesari** Dipartimento di Matematica, Politecnico di Milano, Milano, Italy  
Lamsade, PSL, Université Paris-Dauphine, Paris, France

**Margherita Maria Ferrari** Dipartimento di Matematica, Politecnico di Milano, Milano, Italy

**Mario Alberto García-Meza** Escuela Superior de Economía, Instituto Politécnico Nacional, México City, Mexico

**Elena Gubar** Faculty of Applied Mathematics and Control Processes, St. Petersburg State University, St. Petersburg, Russia

**Ekaterina Gromova** St. Petersburg State University, St. Petersburg, Russia

**Suriya Kumacheva** Faculty of Applied Mathematics and Control Processes, St. Petersburg State University, St. Petersburg, Russia

**Gerasimos Lianos** Department of Economics, School of Business Administration, University of Miami, Coral Gables, FL, USA

**José Daniel López-Barrientos** Facultad de Ciencias Actuariales, Universidad Anáhuac México, Edo. de México, Mexico

**Jacek Mercik** WSB University in Wrocław, Wrocław, Poland  
WSB University in Gdansk, Gdansk, Poland

**Natalia Naumova** St. Petersburg State University, St. Petersburg, Russia

**Ayça Özdoğan** Department of Economics, TOBB University of Economics and Technology, Ankara, Turkey

**Vladimir V. Pisyakov** National Research University Higher School of Economics, Moscow, Russia

**Olga Porokhnyavaya** Faculty of Applied Mathematics and Control Processes, St. Petersburg State University, St. Petersburg, Russia

**David M. Ramsey** Department of Operations Research, Wrocław University of Technology, Wrocław, Poland

**Michel Rudnianski** ORT France, Paris, France

**Utsav Sadana** ORT France, Paris France

**Joss Sánchez-Pérez** Faculty of Economics, UASLP, San Luis Potosí, Mexico

**Marina Sandomirskaja** National Research University Higher School of Economics, Moscow, Russia

**Igor Sloev** National Research University Higher School of Economics, Moscow, Russia

**Pierre von Mouche** Wageningen Universiteit en Researchcentrum, Wageningen, The Netherlands

**Vyacheslav I. Yakuba** International Laboratory of Decision Choice and Analysis, National Research University Higher School of Economics, Moscow, Russia

**Nikolay Zenkevich** Center for International Logistics and Supply Chain Management of DB & RZD, Graduate School of Management, St. Petersburg, Russia

**Ekaterina Zhitkova** Faculty of Applied Mathematics and Control Processes, St. Petersburg State University, St. Petersburg, Russia

**Andrey Zyatchin** Center for International Logistics and Supply Chain Management of DB & RZD, Graduate School of Management, St. Petersburg, Russia