## **Springer Proceedings in Mathematics & Statistics**

Volume 358

This book series features volumes composed of selected contributions from workshops and conferences in all areas of current research in mathematics and statistics, including operation research and optimization. In addition to an overall evaluation of the interest, scientific quality, and timeliness of each proposal at the hands of the publisher, individual contributions are all refereed to the high quality standards of leading journals in the field. Thus, this series provides the research community with well-edited, authoritative reports on developments in the most exciting areas of mathematical and statistical research today.

More information about this series at http://www.springer.com/series/10533

Alexey N. Karapetyants • Igor V. Pavlov • Albert N. Shiryaev Editors

## Operator Theory and Harmonic Analysis

OTHA 2020, Part II – Probability-Analytical Models, Methods and Applications



*Editors* Alexey N. Karapetyants Institute of Mathematics, Mechanic and Computer Sciences and Regional Mathematical Center Southern Federal University Rostov-on-Don, Russia

Albert N. Shiryaev Steklov Mathematical Institute Russian Academy of Sciences Moscow, Russia Igor V. Pavlov Department of Higher Mathematics Don State Technical University Rostov-on-Don, Russia

 ISSN 2194-1009
 ISSN 2194-1017 (electronic)

 Springer Proceedings in Mathematics & Statistics
 ISBN 978-3-030-76828-7
 ISBN 978-3-030-76829-4 (eBook)

 https://doi.org/10.1007/978-3-030-76829-4

Mathematics Subject Classification: 26-02, 30-02, 32-02, 35-02, 42-02, 45-02, 46-02, 47-02, 60-02, 92-02

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2021

This work is subject to copyright. All rights are solely and exclusively licensed 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, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG. The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

## Preface

This is the second volume of the two-volume series entitled

Operator Theory and Harmonic Analysis.

Vol. 1: New General Trends and Advances of the Theory

and

Vol. 2: Probability-Analytical Models, Methods, and Applications.

Volume 1 is devoted to harmonic analysis and its applications in general, while Volume 2 is focused on probabilistic and mathematical (statistical) methods in applied sciences, but still in the context of general harmonic analysis and its numerous applications.

The volumes' readership is the pool of researchers interested in various aspects of harmonic analysis and operator theory: real and complex variable methods, applications to PDE's, mathematical modeling based on applied harmonic analysis and probability-analytical methods, and exploration of new themes and trends.

The contributions to both volumes are based on the matter supposed to be presented at the annual International Scientific Conference on Modern Methods and Problems of Operator Theory and Harmonic Analysis and Their Applications (OTHA-2020, http://otha.sfedu.ru/), canceled due to Covid19 restrictions.

The Editors are very grateful to all the authors for their valuable contributions and for a strong willingness to support mathematical activities and communications in the hope of the soonest resumption of regular conferences and safe mutual visits. The Editors express an immense sorrow on the occasion of the recent loss of remarkable scientists and brilliant persons, Hrachik Hayrapetyan (Armenia), who is one of the authors of the first volume, and Vladimir Pilidi (Russia), who was an active member of Program Committees of OTHA conferences, and Vladimir Nogin (Russia), who was colleague and teacher of quite a few participants of OTHA. The first volume contains words in memoriam of our dear friends Hrachik Hayrapetyan, Vladimir Pilidi, and Vladimir Nogin.

Rostov-on-Don, Russia

Moscow, Russia

A. Karapetyants I. Pavlov A. Shiryaev

## Contents

A Conditional Functional Limit Theorem for a Decomposable Branching Process	1
V. I. Afanasyev	
A Probabilistic Interpretation of Conservation and Balance Laws Ya. I. Belopolskaya	19
Hierarchical Schrödinger Type Operators: The Case of Locally Bounded Potentials	43
A Model for the Outbreak of COVID-19: Vaccine Effectiveness in a Case Study of Italy Vasiliki Bitsouni, Nikolaos Gialelis and Ioannis G. Stratis	91
Rate of Convergence to the Poisson Law of the Numbers of Cycles in the Generalized Random Graphs Sergey G. Bobkov, Maria A. Danshina, and Vladimir V. Ulyanov	109
<b>Combinatorial Identities with Binomial Coefficients</b> Ya. M. Erusalimsky	135
Random Tempered Distributions on Locally Compact Separable Abelian Groups Manuel L. Esquível and Nadezhda P. Krasii	147
On Solutions of Stochastic Equations with Current and Osmotic Velocities Yuri E. Gliklikh	167
Stochastic Methods in Investigation of Modern Networks Vladimir A. Gorlov and Alla V. Makarova	185

Double-Barrier Option Pricing under the Hyper-ExponentialJump Diffusion ModelS. M. Grudsky and O. A. Mendez-Lara	197
Single Jump Filtrations: Preservation of the Local Martingale Property with Respect to the Filtration Generated by the Local Martingale Alexander A. Gushchin and Assylliya K. Zhunussova	219
Local Time and Local Reflection of the Wiener Process I. A. Ibragimov, N. V. Smorodina, and M. M. Faddeev	233
Random Harmonic Processes with New Properties Elena Karachanskaya	243
On Solvability of One Nonlinear Integral Equation Arising in Modelling of Geographical Spread of Epidemics A. Kh. Khachatryan	253
A Simple Wiener-Hopf Factorization Approach for Pricing Double Barrier Options Oleg Kudryavtsev	273
New Procedure for Applying the Cramér–von Mises Test for Parametric Families of Distributions Gennady Martynov	293
<b>CVaR Hedging in Defaultable Jump-Diffusion Markets</b> Alexander Melnikov and Hongxi Wan	309
Out-of-Sample Utility Bounds for Empirically Optimal Portfolios in a Single-Period Investment Problem Dmitry B. Rokhlin	335
A Guaranteed Deterministic Approach to Superhedging: Optimal Mixed Strategies of the Market and Their Supports Sergey N. Smirnov	355
Some Properties of Regularly Varying Functions and Series in the Orthant A. L. Yakymiv	373
Influence of the Configuration of Particle Generation Sources on the Behavior of Branching Walks: A Case Study E. B. Yarovaya	387
Lanchester Model with the Random Coefficients V. G. Zadorozhniy	407