

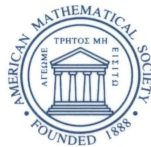
CONTEMPORARY MATHEMATICS

212

Operator Theory for Complex and Hypercomplex Analysis

Operator Theory for Complex
and Hypercomplex Analysis
December 12–17, 1994
Mexico City, Mexico

E. Ramírez de Arellano
N. Salinas
M. V. Shapiro
N. L. Vasilevski
Editors



Selected Titles in This Series

- 212 **E. Ramírez de Arellano, N. Salinas, M. V. Shapiro, and N. L. Vasilevski, Editors**, Operator theory for complex and hypercomplex analysis, 1998
- 211 **Józef Dodziuk and Linda Keen, Editors**, Lipa's legacy: Proceedings from the Bers Colloquium, 1997
- 210 **V. Kumar Murty and Michel Waldschmidt, Editors**, Number theory, 1997
- 209 **Steven Cox and Irena Lasiecka, Editors**, Optimization methods in partial differential equations, 1997
- 208 **Michel L. Lapidus, Lawrence H. Harper, and Adolfo J. Rumbos, Editors**, Harmonic analysis and nonlinear differential equations: A volume in honor of Victor L. Shapiro, 1997
- 207 **Yujiro Kawamata and Vyacheslav V. Shokurov, Editors**, Birational algebraic geometry: A conference on algebraic geometry in memory of Wei-Liang Chow (1911–1995), 1997
- 206 **Adam Korányi, Editor**, Harmonic functions on trees and buildings, 1997
- 205 **Paulo D. Cordaro and Howard Jacobowitz, Editors**, Multidimensional complex analysis and partial differential equations: A collection of papers in honor of François Trèves, 1997
- 204 **Yair Censor and Simeon Reich, Editors**, Recent developments in optimization theory and nonlinear analysis, 1997
- 203 **Hanna Nencka and Jean-Pierre Bourguignon, Editors**, Geometry and nature: In memory of W. K. Clifford, 1997
- 202 **Jean-Louis Loday, James D. Stasheff, and Alexander A. Voronov, Editors**, Operads: Proceedings of Renaissance Conferences, 1997
- 201 **J. R. Quine and Peter Sarnak, Editors**, Extremal Riemann surfaces, 1997
- 200 **F. Dias, J.-M. Ghidaglia, and J.-C. Saut, Editors**, Mathematical problems in the theory of water waves, 1996
- 199 **G. Banaszak, W. Gajda, and P. Krasoń, Editors**, Algebraic K -theory, 1996
- 198 **Donald G. Saari and Zhihong Xia, Editors**, Hamiltonian dynamics and celestial mechanics, 1996
- 197 **J. E. Bonin, J. G. Oxley, and B. Servatius, Editors**, Matroid theory, 1996
- 196 **David Bao, Shiing-shen Chern, and Zhongmin Shen, Editors**, Finsler geometry, 1996
- 195 **Warren Dicks and Enric Ventura**, The group fixed by a family of injective endomorphisms of a free group, 1996
- 194 **Seok-Jin Kang, Myung-Hwan Kim, and Insok Lee, Editors**, Lie algebras and their representations, 1996
- 193 **Chongying Dong and Geoffrey Mason, Editors**, Moonshine, the Monster, and related topics, 1996
- 192 **Tomek Bartoszyński and Marion Scheepers, Editors**, Set theory, 1995
- 191 **Tuong Ton-That, Kenneth I. Gross, Donald St. P. Richards, and Paul J. Sally, Jr., Editors**, Representation theory and harmonic analysis, 1995
- 190 **Mourad E. H. Ismail, M. Zuhair Nashed, Ahmed I. Zayed, and Ahmed F. Ghaleb, Editors**, Mathematical analysis, wavelets, and signal processing, 1995
- 189 **S. A. M. Marcantognini, G. A. Mendoza, M. D. Morán, A. Octavio, and W. O. Urbina, Editors**, Harmonic analysis and operator theory, 1995
- 188 **Alejandro Adem, R. James Milgram, and Douglas C. Ravenel, Editors**, Homotopy theory and its applications, 1995
- 187 **G. W. Brumfiel and H. M. Hilden**, $SL(2)$ representations of finitely presented groups, 1995
- 186 **Shreeram S. Abhyankar, Walter Feit, Michael D. Fried, Yasutaka Ihara, and Helmut Voelklein, Editors**, Recent developments in the inverse Galois problem, 1995

(Continued in the back of this publication)

Operator Theory for Complex and Hypercomplex Analysis

CONTEMPORARY MATHEMATICS

212

Operator Theory for Complex and Hypercomplex Analysis

Operator Theory for Complex
and Hypercomplex Analysis
December 12-17, 1994
Mexico City, Mexico

E. Ramírez de Arellano
N. Salinas
M. V. Shapiro
N. L. Vasilevski
Editors



American Mathematical Society
Providence, Rhode Island

Editorial Board

Dennis DeTurck, managing editor

Andy Magid
Clark Robinson

Michael Vogelius
Peter M. Winkler

This volume contains the proceedings of an international conference that took place in Mexico City, December 12–17, 1994. The subject of the conference was chosen to highlight the interplay between operator theory and complex and hypercomplex analysis as well as to study some classes of operators appearing in them.

Support was provided by the Center for Research and Advanced Study (CINVESTAV-IPN), the School of Physics and Mathematics of the National Polytechnic Institute (ESFM-IPN), the Consejo Nacional de Ciencia y Tecnología (CONACYT-México), and the National Science Foundation (NSF-USA).

1991 *Mathematics Subject Classification*. Primary 47–02;
Secondary 47D30, 47G10, 30G35, 32–02.

Library of Congress Cataloging-in-Publication Data

Operator theory for complex and hypercomplex analysis : a conference on operator theory for complex and hypercomplex analysis, December 12–17, 1994, Mexico City, Mexico / E. Ramírez de Arellano... [et al.], editors.

p. cm. — (Contemporary mathematics, ISSN 0271-4132 ; 212)

Includes bibliographical references.

ISBN 0-8218-0677-7 (softcover : alk. paper)

1. Operator theory—Congresses. 2. Functions of complex variables—Congresses. 3. Mathematical analysis—Congresses. I. Ramírez de Arellano, E. (Enrique) II. Series: Contemporary mathematics (American Mathematical Society) ; v. 212.

QA329.O6365 1997

515'.724—dc21

97-28599

CIP

Copying and reprinting. Material in this book may be reproduced by any means for educational and scientific purposes without fee or permission with the exception of reproduction by services that collect fees for delivery of documents and provided that the customary acknowledgment of the source is given. This consent does not extend to other kinds of copying for general distribution, for advertising or promotional purposes, or for resale. Requests for permission for commercial use of material should be addressed to the Assistant to the Publisher, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940-6248. Requests can also be made by e-mail to reprint-permission@ams.org.

Excluded from these provisions is material in articles for which the author holds copyright. In such cases, requests for permission to use or reprint should be addressed directly to the author(s). (Copyright ownership is indicated in the notice in the lower right-hand corner of the first page of each article.)

© 1998 by the American Mathematical Society. All rights reserved.

The American Mathematical Society retains all rights
except those granted to the United States Government.

Printed in the United States of America.

⊗ The paper used in this book is acid-free and falls within the guidelines
established to ensure permanence and durability.

Visit the AMS home page at URL: <http://www.ams.org/>

10 9 8 7 6 5 4 3 2 1 03 02 01 00 99 98

CONTENTS

Preface	ix
The Bergman projection on sectorial domains DAVID E. BARRETT	1
Subelliptic geometry RICHARD BEALS, BERNARD GAVEAU, AND PETER GREINER	25
Higher order Cauchy Pompeiu operators HEINRICH BEGEHR AND GERALD N. HILE	41
A polydisk version of Beurling's characterization for invariant subspaces of finite multi-codimension MISCHA COTLAR AND CORA SADOSKY	51
A representation of solutions with singularities BERT FISCHER AND NIKOLAI TARKHANOV	57
Bounded monogenic functions on unbounded domains EDWIN FRANKS AND JOHN RYAN	71
L^2 holomorphic functions on pseudo-convex coverings M. GROMOV, G. HENKIN, AND M. SHUBIN	81
On some operators in Clifford analysis KLAUS GÜRLEBECK	95
Toeplitz C^* -algebras over non-convex cones and pseudo-symmetric spaces U. HAGENBACH AND H. UPMEIER	109
On an application of the Bochner–Martinelli operator A. M. KYTMANOV AND S. G. MYSLIVETS	133
Local estimates for fractional integral operators and potentials N. K. KARAPETYANTS	137
Hankel operators on Clifford valued Bergman space CHUN LI AND ZHIJIAN WU	143
Weitzenböck type formulas and joint seminormality MIRCEA MARTIN AND NORBERTO SALINAS	157
C^* -algebras of pseudodifferential operators and limit operators V. S. RABINOVICH	169

Bargmann projection, three-valued functions and corresponding Toeplitz operators ENRIQUE RAMÍREZ DE ARELLANO AND NIKOLAI VASILEVSKI	185
Singular integral operators in the $\bar{\partial}$ theory on convex domains in \mathbb{C}^n R. MICHAEL RANGE	197
Differentiation and integration of variable order and the spaces $L^{p(x)}$ STEFAN G. SAMKO	203
Twistor quantization of loop spaces and general Kähler manifolds A. G. SERGEEV	221
On a class of integral representations related to the two-dimensional Helmholtz operator MICHAEL SHAPIRO AND LUIS MANUEL TOVAR	229
Cocycles on the gauge group and the algebra of Chern-Simons classes M. M. SMIRNOV	245
Boundary value problems treated with methods of Clifford analysis WOLFGANG SPRÖSSIG	255
Analytic models of the quantum harmonic oscillator FRANCISZEK HUGON SZAFRANIEC	269
Interesting relations in Fock space ALEXANDER TURBINER	277
Quantization: Some problems, tools, and applications ANDRÉ UNTERBERGER	285

PREFACE

Integral representations for different classes of functions in analysis motivate the introduction and study of a series of important operators: singular integral, Toeplitz, Bergman, convolution operators on Lie groups, some classes of pseudo-differential operators, etc. Investigation of these operators develops and enriches “pure” operator theory and exerts a stimulating influence on important areas of analysis.

This volume contains the proceedings of an international conference that took place in Mexico City, December 12–17, 1994. The subject of the conference was chosen to highlight the interplay between operator theory and complex and hypercomplex analysis as well as to study some classes of operators appearing in them.

The editors wish to thank the contributors to this volume and also the referees for their many helpful comments to the authors. They wish to apologize for the unfortunate delay of its publication but it was not easy to interact through the pitfalls of communication among different countries, computer systems, and various incompatible codes. The task of the editors was made not only possible but infinitely much easier by the cooperation and technical assistance of Mrs. Larisa Martin, who retyped some of the manuscripts in the appropriate form, formatted all the manuscripts according to the Contemporary Math. Journal specifications, and put together the final version of the volume for publication. The editors are indebted to her.

The conference was made possible thanks to the generous support of the Center for Research and Advanced Study (CINVESTAV-IPN) and of the School of Physics and Mathematics of the National Polytechnic Institute (ESFM-IPN). Special thanks is due to the Consejo Nacional de Ciencia y Tecnología (CONACYT-México) and to the National Science Foundation (NSF-USA) for their financial support.

The Editors

Selected Titles in This Series

(Continued from the front of this publication)

- 185 **Raúl E. Curto, Ronald G. Douglas, Joel D. Pincus, and Norberto Salinas, Editors**, *Multivariable operator theory*, 1995
- 184 **L. A. Bokut', A. I. Kostrikin, and S. S. Kutateladze, Editors**, *Second International Conference on Algebra*, 1995
- 183 **William C. Connett, Marc-Olivier Gebuhrer, and Alan L. Schwartz, Editors**, *Applications of hypergroups and related measure algebras*, 1995
- 182 **Selman Akbulut, Editor**, *Real algebraic geometry and topology*, 1995
- 181 **Mila Cenkli and Haynes Miller, Editors**, *The Čech Centennial*, 1995
- 180 **David E. Keyes and Jinchao Xu, Editors**, *Domain decomposition methods in scientific and engineering computing*, 1994
- 179 **Yoshiaki Maeda, Hideki Omoro, and Alan Weinstein, Editors**, *Symplectic geometry and quantization*, 1994
- 178 **Hélène Barcelo and Gil Kalai, Editors**, *Jerusalem Combinatorics '93*, 1994
- 177 **Simon Gindikin, Roe Goodman, Frederick P. Greenleaf, and Paul J. Sally, Jr., Editors**, *Representation theory and analysis on homogeneous spaces*, 1994
- 176 **David Ballard**, *Foundational aspects of "non"standard mathematics*, 1994
- 175 **Paul J. Sally, Jr., Moshe Flato, James Lepowsky, Nicolai Reshetikhin, and Gregg J. Zuckerman, Editors**, *Mathematical aspects of conformal and topological field theories and quantum groups*, 1994
- 174 **Nancy Childress and John W. Jones, Editors**, *Arithmetic geometry*, 1994
- 173 **Robert Brooks, Carolyn Gordon, and Peter Perry, Editors**, *Geometry of the spectrum*, 1994
- 172 **Peter E. Kloeden and Kenneth J. Palmer, Editors**, *Chaotic numerics*, 1994
- 171 **Rüdiger Göbel, Paul Hill, and Wolfgang Liebert, Editors**, *Abelian group theory and related topics*, 1994
- 170 **John K. Beem and Krishan L. Duggal, Editors**, *Differential geometry and mathematical physics*, 1994
- 169 **William Abikoff, Joan S. Birman, and Kathryn Kuiken, Editors**, *The mathematical legacy of Wilhelm Magnus*, 1994
- 168 **Gary L. Mullen and Peter Jau-Shyong Shiue, Editors**, *Finite fields: Theory, applications, and algorithms*, 1994
- 167 **Robert S. Doran, Editor**, *C^* -algebras: 1943–1993*, 1994
- 166 **George E. Andrews, David M. Bressoud, and L. Alayne Parson, Editors**, *The Rademacher legacy to mathematics*, 1994
- 165 **Barry Mazur and Glenn Stevens, Editors**, *p -adic monodromy and the Birch and Swinnerton-Dyer conjecture*, 1994
- 164 **Cameron Gordon, Yoav Moriah, and Bronislaw Wajnryb, Editors**, *Geometric topology*, 1994
- 163 **Zhong-Ci Shi and Chung-Chun Yang, Editors**, *Computational mathematics in China*, 1994
- 162 **Ciro Ciliberto, E. Laura Livorni, and Andrew J. Sommese, Editors**, *Classification of algebraic varieties*, 1994
- 161 **Paul A. Schweitzer, S. J., Steven Hurder, Nathan Moreira dos Santos, and José Luis Arraut, Editors**, *Differential topology, foliations, and group actions*, 1994
- 160 **Niky Kamran and Peter J. Olver, Editors**, *Lie algebras, cohomology, and new applications to quantum mechanics*, 1994
- 159 **William J. Heinzer, Craig L. Huneke, and Judith D. Sally, Editors**, *Commutative algebra: Syzygies, multiplicities, and birational algebra*, 1994
- 158 **Eric M. Friedlander and Mark E. Mahowald, Editors**, *Topology and representation theory*, 1994
- 157 **Alfio Quarteroni, Jacques Periaux, Yuri A. Kuznetsov, and Olof B. Widlund, Editors**, *Domain decomposition methods in science and engineering*, 1994

(See the AMS catalog for earlier titles)

Operator Theory for Complex and Hypercomplex Analysis

E. Ramírez de Arellano, N. Salinas, M. V. Shapiro, and
N. L. Vasilevski, Editors

This book presents a collection of papers on certain aspects of general operator theory related to classes of important operators: singular integral, Toeplitz and Bergman operators, convolution operators on Lie groups, pseudodifferential operators, etc. The study of these operators arises from integral representations for different classes of functions, enriches pure operator theory, and is influential and beneficial for important areas of analysis. Particular attention is paid to the fruitful interplay of recent developments of complex and hypercomplex analysis on one side and to operator theory on the other. The majority of papers illustrate this interplay as well as related applications. The papers represent the proceedings of the conference "Operator Theory for Complex and Hypercomplex Analysis", held in December 1994 in Mexico City.

ISBN 0-8218-0677-7



9 780821 806777