CONTEMPORARY MATHEMATICS

127

Geometry and Nonlinear Partial Differential Equations



American Mathematical Society

http://dx.doi.org/10.1090/conm/127

Geometry and Nonlinear Partial Differential Equations

Recent Titles in This Series

- 127 Vladimir Oliker and Andrejs Treibergs, Editors, Geometry and nonlinear partial differential equations, 1992
- 126 **R. Keith Dennis, Claudio Pedrini, and Michael R. Stein, Editors,** Algebraic K-theory, commutative algebra, and algebraic geometry, 1992
- 125 F. Thomas Bruss, Thomas S. Ferguson, and Stephen M. Samuels, Editors, Strategies for sequential search and selection in real time, 1992
- 124 Darrell Haile and James Osterburg, Editors, Azumaya algebras, actions, and modules, 1992
- 123 Steven L. Kleiman and Anders Thorup, Editors, Enumerative algebraic geometry, 1991
- 122 D. H. Sattinger, C. A. Tracy, and S. Venakides, Editors, Inverse scattering and applications, 1991
- 121 Alex J. Feingold, Igor B. Frenkel, and John F. X. Ries, Spinor construction of vertex operator algebras, triality, and $E_8^{(1)}$, 1991
- 120 **Robert S. Doran, Editor,** Selfadjoint and nonselfadjoint operator algebras and operator theory, 1991
- 119 **Robert A. Melter, Azriel Rosenfeld, and Prabir Bhattacharya, Editors,** Vision geometry, 1991
- 118 Yan Shi-Jian, Wang Jiagang, and Yang Chung-chun, Editors, Probability theory and its applications in China, 1991
- 117 Morton Brown, Editor, Continuum theory and dynamical systems, 1991
- 116 Brian Harbourne and Robert Speiser, Editors, Algebraic geometry: Sundance 1988, 1991
- 115 Nancy Flournoy and Robert K. Tsutakawa, Editors, Statistical multiple integration, 1991
- 114 Jeffrey C. Lagarias and Michael J. Todd, Editors, Mathematical developments arising from linear programming, 1990
- 113 Eric Grinberg and Eric Todd Quinto, Editors, Integral geometry and tomography, 1990
- 112 Philip J. Brown and Wayne A. Fuller, Editors, Statistical analysis of measurement error models and applications, 1990
- 111 Earl S. Kramer and Spyros S. Magliveras, Editors, Finite geometries and combinatorial designs, 1990
- 110 Georgia Benkart and J. Marshall Osborn, Editors, Lie algebras and related topics, 1990
- 109 Benjamin Fine, Anthony Gaglione, and Francis C. Y. Tang, Editors, Combinatorial group theory, 1990
- 108 Melvyn S. Berger, Editor, Mathematics of nonlinear science, 1990
- 107 Mario Milman and Tomas Schonbek, Editors, Harmonic analysis and partial differential equations, 1990
- 106 Wilfried Sieg, Editor, Logic and computation, 1990
- 105 Jerome Kaminker, Editor, Geometric and topological invariants of elliptic operators, 1990
- 104 Michael Makkai and Robert Paré, Accessible categories: The foundations of categorical model theory, 1989
- 103 Steve Fisk, Coloring theories, 1989
- 102 Stephen McAdam, Primes associated to an ideal, 1989
- 101 S.-Y. Cheng, H. Choi, and Robert E. Greene, Editors, Recent developments in geometry, 1989
- 100 W. Brent Lindquist, Editor, Current progress in hyperbolic systems: Riemann problems and computations, 1989
- 99 Basil Nicolaenko, Ciprian Foias, and Roger Temam, Editors, The connection between infinite dimensional and finite dimensional dynamical systems, 1989
- 98 Kenneth Appel and Wolfgang Haken, Every planar map is four colorable, 1989

(Continued in the back of this publication)

CONTEMPORARY MATHEMATICS

127

Geometry and Nonlinear Partial Differential Equations

Proceedings of the AMS Special Session held March 23–24, 1990

> Vladimir Oliker Andrejs Treibergs Editors



American Mathematical Society Providence, Rhode Island

EDITORIAL BOARD

Richard W. Beals, managing editor Craig Huneke Linda Preiss Rothschild Clark Robinson Peter Winkler

The Proceedings of the Special Session on Geometry, Physics, and Nonlinear Partial Differential Equations held at the 856th meeting of the American Mathematical Society at the University of Arkansas, Fayetteville, Arkansas, March 23–24, 1990.

1991 Mathematics Subject Classification. Primary 35K15, 53B30, 53C15, 53C20.

Library of Congress Cataloging-in-Publication Data

Geometry and nonlinear partial differential equations: proceedings of the AMS special session held March 23–24, 1990/Vladimir Oliker, Andrejs Treibergs, editors.

p. cm.-(Contemporary mathematics; 127)

ISBN 0-8218-5135-7

 1. Differential equations, Nonlinear—Congresses.
 2. Mathematical

 physics—Congresses.
 3. Geometry—Congresses.
 I. Oliker, Vladimir, 1945–.

 Andrejs, 1952–.
 III. American Mathematical Society, Meeting, (1990: Fayetteville, Ark.)

 IV. Series: Contemporary mathematics (American Mathematical Society); v. 127.

 QA377.G46
 1991

 515['].353—dc20
 CIP

Copying and reprinting. Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy a chapter for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews, provided the customary acknowledgment of the source is given.

Republication, systematic copying, or multiple reproduction of any material in this publication (including abstracts) is permitted only under license from the American Mathematical Society. Requests for such permission should be addressed to the Manager of Editorial Services, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940-6248.

The owner consents to copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law, provided that a fee of \$1.00 plus \$.25 per page for each copy be paid directly to the Copyright Clearance Center, Inc., 27 Congress Street, Salem, Massachusetts 01970. When paying this fee please use the code 0271-4132/92 to refer to this publication. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale.

Copyright ©1992 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. \bigotimes

Portions of this volume were prepared using $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -T_EX, the American Mathematical Society's T_EX macro system. Some of the articles were prepared by the authors.

10 9 8 7 6 5 4 3 2 1 97 96 95 94 93 92

Contents

Preface	vii
Null directions and curvature JOHN K. BEEM AND PHILLIP E. PARKER	1
Generalized stereographic projections with prescribed scalar curvature PHILLIPPE DELANOE	17
The conjugacy index and simple astigmatic focusing PAUL E. EHRLICH AND GERARD G. EMCH	27
On the size of the blow-up set for a quasilinear parabolic equation MICHAEL E. GAGE	41
Contact 3-manifolds with positive scalar curvature S. I. GOLDBERG AND D. PERRONE	59
Remarks on the operator div $(\nabla u / \nabla u)$ BERNHARD KAWOHL	69
Finite inverse spectral geometry JEFFREY M. LEE	85
Conformal metrics with singularities and finite negative total curvature on Riemann surfaces ROBERT C. MCOWEN	101
How to hear the volume of convex domains PETER LI, ANDREJS TREIBERGS, AND S. T. YAU	109
Gradient estimates for solutions of nonlinear parabolic oblique boundary problem NINA URALTSEVA	119
Liouville theorems and regularity of minimizing harmonic maps into super- strongly unstable manifolds S. WALTER WEI	131

Preface

In March of 1990, at the AMS meeting in Fayetteville, Arkansas, a Special Session on recent developments in "Geometry, Physics, and Nonlinear PDE's" was held. For this conference, we invited specialists working in the areas of Monge-Ampere equations, prescribed curvature problems, mean curvature, harmonic maps, evolution with curvature dependent speed, isospectral manifolds, and general relativity. In recent years, there has been an enormous surge of activity in the above areas and we received an overwhelming response to our invitations. Twenty-five thirty-minute addresses were delivered in the Session. The majority of papers in the present volume are expositions of these addresses.

We thank all our colleagues who participated in the Session and contributed to this volume. We are indebted to the American Mathematical Society for the generous help with the organization of the Session and publishing of its Proceedings.

> Vladimir Oliker Atlanta

Andrejs Treibergs Salt Lake City

Recent Titles in This Series

(Continued from the front of this publication)

- 97 J. E. Marsden, P. S. Krishnaprasad, and J. C. Simo, Editors, Dynamics and control of multibody systems, 1989
- 96 Mark Mahowald and Stewart Priddy, Editors, Algebraic topology, 1989
- 95 Joel V. Brawley and George E. Schnibben, Infinite algebraic extensions of finite fields, 1989
- 94 R. Daniel Mauldin, R. M. Shortt, and Cesar E. Silva, Editors, Measure and measurable dynamics, 1989
- 93 M. Isaacs, A. Lichtman, D. Passman, S. Sehgal, N. J. A. Sloane, and H. Zassenhaus, Editors, Representation theory, group rings, and coding theory, 1989
- 92 John W. Gray and Andre Scedrov, Editors, Categories in computer science and logic, 1989
- 91 David Colella, Editor, Commutative harmonic analysis, 1989
- 90 Richard Randell, Editor, Singularities, 1989
- 89 R. Bruce Richter, Editor, Graphs and algorithms, 1989
- 88 R. Fossum, W. Haboush, M. Hochster, and V. Lakshmibai, Editors, Invariant theory, 1989
- 87 Laszlo Fuchs, Rüdiger Göbel, and Phillip Schultz, Editors, Abelian group theory, 1989
- 86 J. Ritter, Editor, Representation theory and number theory in connection with the local Langlands conjecture, 1989
- 85 Bor-Luh Lin, Editor, Banach space theory, 1989
- 84 Stevo Todorcevic, Partition problems in topology, 1989
- 83 Michael R. Stein and R. Keith Dennis, Editors, Algebraic K-theory and algebraic number theory, 1989
- 82 Alexander J. Hahn, Donald G. James, and Zhe-xian Wan, Editors, Classical groups and related topics, 1989
- 81 Kenneth R. Meyer and Donald G. Saari, Editors, Hamiltonian dynamical systems, 1988
- 80 N. U. Prabhu, Editor, Statistical inference from stochastic processes, 1988
- 79 Ernst Kunz and Rolf Waldi, Regular differential forms, 1988
- 78 Joan S. Birman and Anatoly Libgober, Editors, Braids, 1988
- 77 Wang Yuan, Yang Chung-chun, and Pan Chengbiao, Editors, Number theory and its applications in China, 1988
- 76 David C. Hobby and Ralph McKenzie, The structure of finite algebras, 1988
- 75 Frank M. Cholewinski, The finite calculus associated with Bessel functions, 1988
- 74 William M. Goldman and Andy R. Magid, Editors, Geometry of group representations, 1988
- 73 Rick Durrett and Mark A. Pinsky, Editors, Geometry of random motion, 1988
- 72 R. F. Brown, Editor, Fixed point theory and its applications, 1988
- 71 James A. Isenberg, Editor, Mathematics and general relativity, 1988
- 70 Jerome Kaminker, Kenneth C. Millett, and Claude Schochet, Editors, Index theory of elliptic operators, foliations, and operator algebras, 1988
- 69 Walter A. Carnielli and Luiz Paulo de Alcantara, Editors, Methods and applications of mathematical logic, 1988
- 68 Mladen Luksic, Clyde Martin, and William Shadwick, Editors, Differential geometry: The interface between pure and applied mathematics, 1987
- 67 Kenneth A. Ribet, Editor, Current trends in arithmetical algebraic geometry, 1987
- 66 Narian Gupta, Free group rings, 1987
- 65 Stephen G. Simpson, Editor, Logic and combinatorics, 1987

(See the AMS catalogue for earlier titles)

ISBN 0-8218-5135-7