# Pacific 

# Journal of Mathematics 

VOLUME CXLIX<br>1991

## PACIFIC JOURNAL OF MATHEMATICS EDITORS

V. S. Varadarajan (Managing Editor)
University of California
Los Angeles, CA 90024-1555-05
Herbert Clemens
University of Utah
Salt Lake City, UT 84112
Thomas Enright
University of California, San Diego
La Jolla, CA 92093
R. Finn

Stanford University
Stanford, CA 94305
Hermann Flaschka
University of Arizona
Tucson, AZ 85721
Vaughan F. R. Jones
University of California
Berkeley, CA 94720
Steven Kerckhoff
Stanford University
Stanford, CA 94305
C. C. Moore

University of California Berkeley, CA 94720
Martin Scharlemann
University of California
Santa Barbara, CA 93106
Harold Stark
University of California, San Diego La Jolla, CA 92093

## ASSOCIATE EDITORS

$\begin{array}{lllll}\text { R. Arens } & \text { E. F. Beckenbach } & \text { B. H. Neumann } & \text { F. Wolf } & \text { K. Yoshida }\end{array}$ (1906-1982) (1904-1989)

## SUPPORTING INSTITUTIONS

UNIVERSITY OF ARIZONA UNIVERSITY OF BRITISH COLUMBIA
CALIFORNIA INSTITUTE OF TECHNOLOGY
UNIVERSITY OF CALIFORNIA
MONTANA STATE UNIVERSITY UNIVERSITY OF NEVADA, RENO NEW MEXICO STATE UNIVERSITY
OREGON STATE UNIVERSITY

UNIVERSITY OF OREGON
UNIVERSITY OF SOUTHERN CALIFORNIA
STANFORD UNIVERSITY
UNIVERSITY OF HAWAII UNIVERSITY OF TOKYO UNIVERSITY OF UTAH WASHINGTON STATE UNIVERSITY UNIVERSITY OF WASHINGTON

## CONTENTS

A - ALGEBRA AND NUMBER THEORY
M. H. Lee, Conjugates of equivariant holomorphic maps of sym- metric domains ..... 127
P. A. Linnell, Zero divisors and group von Neumann algebras ..... 349
T. L. Smith, Generalized Clifford-Littlewood-Eckmann groups ..... 157
T. L. Smith, Generalized Clifford-Littlewood-Eckmann groups II: Linear representations and applications ..... 185
H. Walum, Multiplication formulae for periodic functions ..... 383
B - ANALYSIS
T. Akahori and H. Ameku, On the Romanov kernel and Kuranishi's $L^{2}$-estimate for $\bar{\partial}_{b}$ over a ball in the strongly pseudo convex boundary ..... 1
H. Ameku, See T. Akahori and H. Ameku
W. Balser, Dependence of differential equations upon parameters in their Stokes' multipliers ..... 211
Y. Kawahigashi, Cohomology of actions of discrete groups on fac- tors of type $\mathrm{II}_{1}$ ..... 303
B. H. Wagner, Classification of essential commutants of abelian von Neumann algebras ..... 365
C - APPLIED MATHEMATICS
H. Engler, A matrix Volterra integrodifferential equation occurring in polymer rheology ..... 25
D - GEOMETRY
M. Alfaro, M. Conger, K. Hodges, A. Levy, R. Kochar, L. Kuklinski, Z. Mahmood, and K. von Haam, The structure of singulari- ties in $\Phi$-minimizing networks in $\mathbf{R}^{2}$ ..... 201
E. Casadio Tarabusi and S. Trapani, Envelopes of holomorphy of Hartogs and circular domains ..... 231
M. Conger, See M. Alfaro, K. Hodges, A. Levy, R. Kochar, L. Kuklinski, Z. Mahmood, and K. von Haam
H. Flaschka and L. Haine, Torus orbits in $G / P$ ..... 251
Z. Ge, On a constrained variational problem and the spaces of horizontal paths ..... 61
K. von Haam, See M. Alfaro, K. Hodges, A. Levy, R. Kochar, L. Kuklinski, Z. Mahmood, and K. von Haam
L. Haine, See H. Flaschka and L. Haine
K. Hodges, See M. Alfaro, K. Hodges, A. Levy, R. Kochar, L.Kuklinski, Z. Mahmood, and K. von Haam
G. D. Johnson, An intrinsic characterization of a class of minimal surfaces in constant curvature manifolds ..... 113
R. Kochar, See M. Alfaro, K. Hodges, A. Levy, R. Kochar, L. Kuklinski, Z. Mahmood, and K. von Haam
L. Kuklinski, See M. Alfaro, K. Hodges, A. Levy, R. Kochar, L. Kuklinski, Z. Mahmood, and K. von Haam
A. Levy, See M. Alfaro, K. Hodges, A. Levy, R. Kochar, L. Kuklinski, Z. Mahmood, and K. von Haam
Z. Mahmood, See M. Alfaro, K. Hodges, A. Levy, R. Kochar, L. Kuklinski, Z. Mahmood, and K. von Haam
S. Trapani, See E. Casadio Tarabusi and S. Trapani
E - LOGIC AND FOUNDATIONS
R. E. Beaudoin, The proper forcing axiom and stationary set re- flection ..... 13
G - TOPOLOGY
Y. Hemmi, Higher homotopy commutativity of H -spaces and the $\bmod p$ torus theorem ..... 95
G. T. Jin, The Cochran sequences of semi-boundary links ..... 293
K. H. Ko and L. Smolinsky, A combinatorial matrix in 3-manifold theory ..... 319
W. B. R. Lickorish, Invariants for 3-manifolds from the combina- torics of the Jones polynomial ..... 337
J. Nikiel, H. M. Tuncali, and E. D. Tymchatyn, On the rim- structure of continuous images of ordered compacta ..... 145
L. Smolinsky, See K. H . Ko and L. SmolinskyH. M. Tuncali, See J. Nikiel, H. M. Tuncali, and E. D. TymchatynE. D. Tymchatyn, See J. Nikiel, H. M. Tuncali, and E. D. Tymchatyn

## Pacific Journal of

## Mathematics

T. Akahori and H. Ameku, On the Romanov kernel and Kuranishi's $L^{2}$-estimate for $\bar{\partial}_{b}$ over a ball in the strongly pseudo convex boundary ..... 1
R. E. Beaudoin, The proper forcing axiom and stationary set reflection ..... 13
H. Engler, A matrix Volterra integrodifferential equation occurring in polymer rheology ..... 25
Z. Ge, On a constrained variational problem and the spaces of horizontal paths ..... 61
Y. Hemmi, Higher homotopy commutativity of $H$-spaces and the $\bmod p$ torus theorem ..... 95
G. D. Johnson, An intrinsic characterization of a class of minimal surfaces in constant curvature manifolds ..... 113
M. H. Lee, Conjugates of equivariant holomorphic maps of symmetric domains ..... 127
J. Nikiel, H. M. Tuncali, and E. D. Tymchatyn, On the rim-structure of continuous images of ordered compacta ..... 145
T. L. Smith, Generalized Clifford-Littlewood-Eckmann groups ..... 157
T. L. Smith, Generalized Clifford-Littlewood-Eckmann groups II: Linear represen- tations and applications ..... 185

# PACIFIC JOURNAL OF MATHEMATICS EDITORS 

V. S. Varadarajan
(Managing Editor)
University of California
Los Angeles, CA 90024-1555-05
Herbert Clemens
University of Utah
Salt Lake City, UT 84112
Thomas Enright
University of California, San Diego
La Jolla, CA 92093

## R. Finn

Stanford University
Stanford, CA 94305
Hermann Flaschka
University of Arizona
Tucson, AZ 85721
Vaughan F. R. Jones
University of California
Berkeley, CA 94720
Steven Kerckhoff
Stanford University
Stanford, CA 94305
C. C. Moore

University of California
Berkeley, CA 94720
Martin Scharlemann
University of California Santa Barbara, CA 93106
Harold Stark
University of California, San Diego La Jolla, CA 92093

ASSOCIATE EDITORS

| R. Arens | E. F. Beckenbach (1906-1982) | B. H. Neumann | $\begin{gathered} \text { F. WolF } \\ (1904-1989) \end{gathered}$ | K. Yoshida |
| :---: | :---: | :---: | :---: | :---: |
| SUPPORTING INSTITUTIONS |  |  |  |  |
| IVERSITY | ARIZONA | UNIVER | OF OREGON |  |
| IIVERSITY | BRITISH COLUMB | UNIVERS | OF SOUTHER | CALIFORNIA |
| LIFORNIA | TITUTE OF TECHI | OGY STANFOR | NIVERSITY |  |
| NIVERSITY | CALIFORNIA | UNIVERS | OF HAWAII |  |
| ONTANA S | E UNIVERSITY | UNIVERS | OF TOKYO |  |
| NIVERSITY | NEVADA, RENO | UNIVERS | OF UTAH |  |
| W MEXIC | ATE UNIVERSITY | WASHING | N STATE UNI | SITY |
| EGON STA | UNIVERSITY | UNIVERS | OF WASHING |  |

The Supporting Institutions listed above contribute to the cost of publication of this Journal, but they are not owners or publishers and have no responsibility for its content or policies.

Mathematical papers intended for publication in the Pacific Journal of Mathematics should be in typed form or offset-reproduced (not dittoed), double spaced with large margins. Please do not use built up fractions in the text of the manuscript. However, you may use them in the displayed equations. Underline Greek letters in red, German in green, and script in blue. The first paragraph must be capable of being used separately as a synopsis of the entire paper. In particular it should contain no bibliographic references. Please propose a heading for the odd numbered pages of less than 35 characters. Manuscripts, in triplicate, may be sent to any one of the editors. Please classify according to the 1991 Mathematics Subject Classification scheme which can be found in the December index volumes of Mathematical Reviews. Supply name and address of author to whom proofs should be sent. All other communications should be addressed to the managing editor, or Elaine Barth, University of California, Los Angeles, California 90024-1555-05.

There are page-charges associated with articles appearing in the Pacific Journal of Mathematics. These charges are expected to be paid by the author's University, Government Agency or Company. If the author or authors do not have access to such Institutional support these charges are waived. Single authors will receive 50 free reprints; joint authors will receive a total of 100 free reprints. Additional copies may be obtained at cost in multiples of 50 .

The Pacific Journal of Mathematics (ISSN 0030-8730) is published monthly except for July and August. Regular subscription rate: $\$ 190.00$ a year ( 10 issues). Special rate: $\$ 95.00$ a year to individual members of supporting institutions.

Subscriptions, orders for numbers issued in the last three calendar years, and changes of address should be sent to Pacific Journal of Mathematics, P.O. Box 969, Carmel Valley, CA 93924, U.S.A. Old back numbers obtainable from Kraus Periodicals Co., Route 100, Millwood, NY 10546.

The Pacific Journal of Mathematics at P.O. Box 969, Carmel Valley, CA 93924 (ISSN 0030-8730) is published monthly except for July and August. Second-class postage paid at Carmel Valley, California 93924, and additional mailing offices. Postmaster: send address changes to Pacific Journal of Mathèmatics, P.O. Box 969, Carmel Valley, CA 93924.

[^0]
[^0]:    PUBLISHED BY PACIFIC JOURNAL OF MATHEMATICS, A NON-PROFIT CORPORATION
    Copyright (c) 1991 by Pacific Journal of Mathematics

