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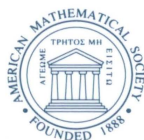
191

## Representation Theory and Harmonic Analysis

A Conference in Honor of Ray A. Kunze  
January 12–14, 1994  
Cincinnati, Ohio

Tuong Ton-That, Coordinating Editor

Kenneth I. Gross  
Donald St. P. Richards  
Paul J. Sally, Jr.  
Editors



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Ray Alden Kunze

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The AMS Special Session on Representation Theory and Harmonic Analysis was held in Cincinnati, Ohio, from January 12–14, 1994.

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## Table of Contents

<b>Dedication</b>	ix
<b>Preface</b>	xi
<b>Supercuspidal Character Formulas for <math>GL_\ell</math></b> LAWRENCE CORWIN, ALLEN MOY and PAUL J. SALLY, Jr.	1
<b>Geometric Realizations for Highest Weight Representations</b> M. G. DAVIDSON and R. C. FABEC	13
<b>Hankel Transforms and Holomorphic Discrete Series</b> HONGMING DING	33
<b>Fonctions Sphériques sur un Espace Symétrique Ordonné de Type Cayley</b> JACQUES FARAUT	41
<b>On Derived Intertwining Norms for the Lorentz Group</b> J. E. GILBERT, R. A. KUNZE and C. MEANEY	57
<b>The Holomorphic Cauchy-Szegő Kernel for Nonholomorphic Discrete Series Representations of <math>SU(2,1)</math></b> SIMON G. GINDIKIN	75
<b>Invariant Theory for Boundary Components</b> KENNETH I. GROSS	83
<b>Decomposition of Exterior Algebras</b> KENNETH D. JOHNSON	99
<b>On a Mean Value Property for Hyperbolic Spaces</b> ADAM KORÁNYI	107

<b>Inversion of an Integral Transform and Ladder Representations of <math>U(1, q)</math></b>	
JOHN D. LORCH and LISA A. MANTINI	117
<b>Fourier Inversion in Several Variables – A New Look at an Old Problem</b>	
MARK A. PINSKY	139
<b>Total Positivity, Harmonic Analysis and Random Walks on Weyl Chambers</b>	
DONALD ST. P. RICHARDS and KENNETH I. GROSS	153
<b>Covariant Differential Operators and Derived Functor Modules</b>	
RONALD J. STANKE	163
<b>Dual Representations and Invariant Theory</b>	
TUONG TON-THAT	205
<b>On the Harish-Chandra Homomorphism of Invariant Differential Operators on a Reductive Lie Algebra</b>	
N. R. WALLACH and M. HUNZIKER	223
<b>Spectral Zeta Series of Rank 1 Space Forms</b>	
FLOYD L. WILLIAMS	245



## Dedication

This volume is dedicated to Ray A. Kunze in recognition of his long and distinguished career as a leading researcher in group representations and harmonic analysis.

Ray Alden Kunze was born March 7, 1928, in Des Moines, Iowa, but lived much of his youth in the area around Milwaukee, Wisconsin. He attended Denison University for two years before transferring to the University of Chicago, where he received his Bachelor of Science and Master of Science degrees, both in mathematics. Ray's graduate studies were interrupted during the early 1950's by military service, during which period he served as a mathematical analyst in the Department of Defense. Upon completion of his tour of duty, Ray returned to his doctoral studies at the University of Chicago, and in 1957 received his Doctor of Philosophy degree in mathematics. His dissertation was written under the supervision of Irving E. Segal.

Ray then went to the Massachusetts Institute of Technology as a C.L.E. Moore Instructor, and over the ensuing years has served on the faculties of Brandeis University, Washington University, the University of California at Irvine, and the University of Georgia. At both Irvine and Georgia he chaired the Department of Mathematics. Ray has also held numerous visiting positions in the United States and abroad.

Ray's mathematical research is characterized by exquisite mathematical taste, deep creative insight, algebraic elegance, and analytical power. His numerous publications include seminal contributions to almost every aspect of group representations and noncommutative harmonic analysis: Fourier transforms on locally compact groups, noncommutative interpolation theory, intertwining operators for the principal series and uniformly bounded representations of semi-simple Lie groups, operator-valued reproducing kernels, holomorphic multiplier representations, generalized Bessel functions and Hankel transforms, analysis on matrix space, the holomorphic discrete series and related representations, the metaplectic (or Segal-Shale-Weil, or oscillator) representation, algebraic induction, invariant theory, and exceptional representations.

Ray is also well-known for his clarity of mathematical exposition. His celebrated textbook on linear algebra, coauthored with Kenneth M. Hoffman, has

been a classic for over three decades and has been translated into several languages. As further testimonial to his reputation as a lecturer, Ray frequently has been invited to teach graduate level summer school courses, for example at NSF and NATO institutes and at universities in Italy, France, and Australia.

No summary of Ray's professional contributions would be complete without taking special note of his extraordinary talents as a mentor of doctoral students. Those who have had the pleasure and privilege of being his student have had the best mathematical training possible. His immense patience in guiding a student from course work to independent research, his clear and precise explanations, his unerring ability to direct a student toward mainstream problems of importance on which one could make steady progress, his unwavering support and encouragement when the going gets rough, his network of contacts through which he helps a student find a position upon completion of the degree, and the lifelong mutual affection and friendship that characterizes his relationship with his students, make Ray a perfect model of what a thesis advisor can and should be.

With pride and great pleasure, we dedicate this volume to Ray as a tribute to his distinguished career as a research mathematician and inspirational teacher. We wish him many more years of good health, happiness, and continued deep and important contributions to mathematics.

## Preface

This volume is an outgrowth of the special session on representation theory and harmonic analysis held in honor of Ray Kunze at the 889th meeting of the American Mathematical Society on January 12-15, 1994, at Cincinnati, Ohio. The mathematicians who gathered together for the special session included many of Ray's former Ph.D. students, research collaborators, and others whose work has been influenced either directly or indirectly through their associations with Ray. As the session progressed, it became clear that the papers being presented spanned a wide spectrum of group representations and applications that would be of interest to a more extensive audience.

For the most part, the papers that appear here are based upon lectures presented at the special session.<sup>1</sup> Although the central theme is group representations and its applications to harmonic analysis, this volume contains a diversity of mathematics. A glance through the table of contents, for example, reveals that the algebraic and geometric points of view in representation theory are also greatly in evidence, and that quite classical analysis in higher dimensions, not particularly closely tied to representation theoretic ideas, appears as well. To convey both the richness and extent of the mathematics included in the volume, we note that the papers relate to many topics, such as the following: analysis, algebra, and geometry on Riemannian, pseudo-Riemannian, and locally Riemannian symmetric spaces; Lie algebra cohomology; projective and integral geometry; representations of semi-simple Lie groups, including the holomorphic discrete series and highest weight representations more generally, non-holomorphic discrete series, the principal series, and exceptional representations; invariant theory and the oscillator representation; invariant differential operators and the work of Harish-Chandra;  $p$ -adic representation theory; and classical Fourier analysis.

In closing, the editors are pleased to recognize and thank two other individuals who helped produce this volume: Barbara Palmore, whose excellent typing and

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<sup>1</sup>A few of the lectures treated research that had already been submitted elsewhere, and of course could not be included in this volume. However, in some cases the topic does appear in the volume as an expository overview of the subject that is not available elsewhere. Conversely, some invited speakers who were unable to attend the special session submitted their work in written form to these proceedings.

formatting of the manuscripts is reflected in the finished product, and Donna Harmon of the A.M.S. staff who provided expert production advice. We also wish to thank the referees for their careful reading of the papers and their helpful comments to authors. Most importantly, the editors are indebted to the speakers at the special session for helping make the event so memorable, and for their encouragement to produce this volume.

Tuong Ton-That  
Kenneth I. Gross  
Donald St. P. Richards  
Paul J. Sally, Jr.

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*(Continued from the front of this publication)*

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