Infinite-Dimensional Groups and Their Representations

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Summary. This article provides an introduction to the representation theory of Banach–Lie groups of operators on Hilbert spaces, where our main focus lies on highest weight representations and their geometric realization as spaces of holomorphic sections of a complex line bundle. After discussing the finite-dimensional case in Section I, we describe the algebraic side of the theory in Sections II and III. Then we turn in Sections IV and V to Banach–Lie groups and holomorphic representations of complex classical groups. The geometry of the coadjoint action is discussed in Section VI, and in the concluding Section VII all threads lead to a full discussion of the theory for the group $U_2(H)$ of unitary operators u on a Hilbert space H for which $u - 1$ is Hilbert–Schmidt.

Introduction

As in finite dimensions, Lie theory is an exciting combination of algebraic and analytic methods. In the finite-dimensional situation one studies a connected Lie group G by the exponential function $\exp: \mathfrak{g} \to G$ which is a local diffeomorphism. Therefore the Lie algebra structure of $\mathfrak{g}$ carries essentially all the local information on G. This means that all groups with the same Lie algebra $\mathfrak{g}$ are quotients of an essentially unique simply connected group $\tilde{G}$ modulo discrete central subgroups. Viewing $\mathfrak{g}$ as a "linearization" of G, the heart of the Lie-theoretic methods is a dictionary translating analytic and global properties of G into algebraic properties of its Lie algebra $\mathfrak{g}$, which are then studied by algebraic methods.

This picture is different for infinite-dimensional groups, and how bad it becomes depends on the setting one is working in. The central objects of this article will be groups of operators on Hilbert spaces. These groups will always have a natural topology for which they are Banach–Lie groups, i.e., manifolds modeled on a Banach space endowed with a smooth group structure (multiplication and inversion). In this setting, one still has an exponential function $\exp: \mathfrak{g} \to G$ which is a local diffeomorphism, hence a good translation mechanism from G to $\mathfrak{g}$ and back. A new feature is that the Lie algebra $\mathfrak{g}$ now is a Banach space with a continuous Lie bracket, a Banach–Lie algebra, so that we need functional analytic as well as algebraic concepts to study the Lie algebra and the group.

Representations Of Infinite Dimensional Groups

A.A. Kirillov

Representations Of Infinite Dimensional Groups:

  Representations of Infinite-dimensional Groups Rais Salmanovich Ismagilov,1996-01-01 This book is devoted to representations of two classes of infinite dimensional groups current groups and diffeomorphism groups The author presents a complete treatment of the subject including general methods for constructing irreducible representations of infinite dimensional groups and general results about such representations He also exhibits deep relations between representations of infinite dimensional groups and the theory of Fock spaces the theory of point random processes and other branches of mathematics   **Infinite Dimensional Groups and Algebras in Quantum Physics** Johnny T. Ottesen,1995-04-18 The idea of writing this book appeared when I was working on some problems related to representations of physically relevant infinite mensional groups of operators on physically relevant Hilbert spaces The considerations were local reducing the subject to dealing with representations of infinite dimensional Lie algebras associated with the associated groups There is a large number of specialized articles and books on parts of this subject but to our suprise only a few represent the point of view given in this book Moreover none of the written material was self contained At present the subject has not reached its final form and active research is still being undertaken I present this subject of growing importance in a unified manner and by a fairly simple approach I present a route by which students can absorb and understand the subject only assuming that the reader is familliar with functional analysis especially bounded and unbounded operators on Hilbert spaces Moreover I assume a little basic knowledge of algebras Lie algebras Lie groups and manifolds at least the definitions The contents are presented in detail in the introduction in Chap The manuscript of this book has been succesfully used by some advanced graduate students at Aarhus University Denmark in their A exame I thank them for comments   Induced Representations of Infinite-dimensional Groups, I Alexander V. Kosyak,2013   Infinite-dimensional Representations of 2-groups ,2012 A 2 group is a category equipped with a multiplication satisfying laws like those of a group Just as groups have representations on vector spaces 2 groups have representations on 2 vector spaces which are categories analogous to vector spaces Unfortunately Lie 2 groups typically have few representations on the finite dimensional 2 vector spaces introduced by Kapranov and Voevodsky For this reason Crane Sheppeard and Yetter introduced certain infinite dimensional 2 vector spaces called measurable categories since they are closely related to measurable fields of Hilbert spaces and used these to study infinite dimensional representations of certain Lie 2 groups Here we continue this work We begin with a detailed study of measurable categories Then we give a geometrical description of the measurable representations intertwiners and 2 intertwiners for any skeletal measurable 2 group We study tensor products and direct sums for representations and various concepts of subrepresentation We describe direct sums of intertwiners and sub intertwiners features not seen in ordinary group representation theory We study irreducible and indecomposable representations and intertwiners We also study irretractable representations another feature not seen in ordinary group representation theory Finally we argue that

measurable categories equipped with some extra structure deserve to be considered separable 2 Hilbert spaces and compare this idea to a tentative definition of 2 Hilbert spaces as representation categories of commutative von Neumann algebras

Infinite Dimensional Groups and Their Representations Karl-Hermann Neeb,2000 **Categories of Symmetries and Infinite-dimensional Groups** Yu. A. Neretin,1996 For mathematicians working in group theory the study of the many infinite dimensional groups has been carried out in an individual and non coherent way For the first time these apparently disparate groups have been placed together in order to construct the big picture This book successfully gives an account of this and shows how such seemingly dissimilar types such as the various groups of operators on Hilbert spaces or current groups are shown to belong to a bigger entitity This is a ground breaking text will be important reading for advanced undergraduate and graduate mathematicians **Regular, Quasi-regular and Induced Representations of Infinite-dimensional Groups** Alexander V. Kosyak,2018 The aim of the book is a systematic development by example of noncommutative harmonic analysis on infinite dimensional non locally compact matrix groups We generalize the notion of regular quasi regular and induced representations for arbitrary infinite dimensional groups The central idea to verify the irreducibility is the Ismagilov conjecture We also extend the Kirillov orbit method for the group of upper triangular matrices of infinite order publisher *Infinite Dimensional Groups with Applications* Victor Kac,1985-10-14 This volume records most of the talks given at the Conference on Infinite dimensional Groups held at the Mathematical Sciences Research Institute at Berkeley California May 10 May 15 1984 as a part of the special program on Kac Moody Lie algebras The purpose of the conference was to review recent developments of the theory of infinite dimensional groups and its applications The present collection concentrates on three very active interrelated directions of the field general Kac Moody groups gauge groups especially loop groups and diffeomorphism groups I would like to express my thanks to the MSRI for sponsoring the meeting to Ms Faye Yeager for excellent typing to the authors for their manuscripts and to Springer Verlag for publishing this volume V Kac INFINITE DIMENSIONAL GROUPS WITH APPLICATIONS CONTENTS The Lie Group Structure of M Adams T Ratiu 1 Diffeomorphism Groups and R Schmid Invertible Fourier Integral Operators with Applications On Landau Lifshitz Equation and E Date 71 Infinite Dimensional Groups Flat Manifolds and Infinite D S Freed 83 Dimensional Kahler Geometry Positive Energy Representations R Goodman 125 of the Group of Diffeomorphisms of the Circle Instantons and Harmonic Maps M A Guest 137 A Coxeter Group Approach to Z Haddad 157 Schubert Varieties Constructing Groups Associated to V G Kac 167 Infinite Dimensional Lie Algebras I Kaplansky 217 Harish Chandra Modules Over the Virasoro Algebra L J Santharoubane 233 Rational Homotopy Theory of Flag S <u>Infinite Dimensional Groups and Algebras in Quantum Physics</u> Johnny T. Ottesen,2008-09-11 The idea of writing this book appeared when I was working on some problems related to representations of physically relevant infinite mensional groups of operators on physically relevant Hilbert spaces The considerations were local reducing the subject to dealing with representations of infinite dimensional Lie algebras associated with the associated

groups There is a large number of specialized articles and books on parts of this subject but to our suprise only a few represent the point of view given in this book Moreover none of the written material was self contained At present the subject has not reached its final form and active research is still being undertaken I present this subject of growing importance in a unified manner and by a fairly simple approach I present a route by which students can absorb and understand the subject only assuming that the reader is familliar with functional analysis especially bounded and unbounded operators on Hilbert spaces Moreover I assume a little basic knowledge of algebras Lie algebras Lie groups and manifolds at least the definitions The contents are presented in detail in the introduction in Chap The manuscript of this book has been succesfully used by some advanced graduate students at Aarhus University Denmark in their A exame I thank them for comments **Representation of Lie Groups and Related Topics** Anatoliĭ Moiseevich Vershik,Dmitriĭ Petrovich Zhelobenko,1990 Eight papers provide mature readers with careful review of progress through about 1983 toward the creation of a theory of the representations of infinite dimensional Lie groups and algebras and of some related topics Recent developments in physics have provided major impetus for the development of such a theory and the volume will be of special interest to mathematical physicists quantum field theorists Translated from the Russian edition of unstated date and beautifully produced which at the price it should be Book club price 118 NW Annotation copyrighted by Book News Inc Portland OR Representation Theory and Noncommutative Harmonic Analysis I A.A. Kirillov,2013-03-09 Part I of this book is a short review of the classical part of representation theory The main chapters of representation theory are discussed representations of finite and compact groups finite and infinite dimensional representations of Lie groups It is a typical feature of this survey that the structure of the theory is carefully exposed the reader can easily see the essence of the theory without being overwhelmed by details The final chapter is devoted to the method of orbits for different types of groups Part II deals with representation of Virasoro and Kac Moody algebra The second part of the book deals with representations of Virasoro and Kac Moody algebra The wealth of recent results on representations of infinite dimensional groups is presented Developments and Trends in Infinite-Dimensional Lie Theory Karl-Hermann Neeb,Arturo Pianzola,2010-10-17 This collection of invited expository articles focuses on recent developments and trends in infinite dimensional Lie theory which has become one of the core areas of modern mathematics The book is divided into three parts infinite dimensional Lie super algebras geometry of infinite dimensional Lie transformation groups and representation theory of infinite dimensional Lie groups Contributors B Allison D Belti W Bertram J Faulkner Ph Gille H Gl ckner K H Neeb E Neher I Penkov A Pianzola D Pickrell T S Ratiu N R Scheithauer C Schweigert V Serganova K Styrkas K Waldorf and J A Wolf **Regular, Quasi-regular and Induced Representations of Infinite-dimensional Groups** Alexander V. Kosyak,2018 Infinite Dimensional Groups with Applications Victor Kac,1985-10-14 *Infinite-dimensional Group Representations* George Whitelaw Mackey,American Mathematical Society,1961 **Infinite-Dimensional Lie Algebras** Victor G. Kac,1990 The third

substantially revised edition of a monograph concerned with Kac Moody algebras a particular class of infinite dimensional Lie albegras and their representations based on courses given over a number of years at MIT and in Paris   Infinite Dimensional Lie Algebras And Groups Victor G Kac,1989-07-01 Contents Integrable Representation of Kac Moody Algebras Results and Open Problems V Chari A Pressley Existence of Certain Components in the Tensor Product of Two Integrable Highest Weight Modules for Kac Moody Algebras SKumar Frobenius Action on the B Cohomology O Mathieu Certain Rank Two Subsystems of Kac Moody Root Systems J Morita Lie Groups Associated to Kac Moody Lie Algebras An Analytic Approach E Rodriguez Carrington Almost Split K Forms of Kac Moody Algebras G Rousseau Global Representations of the Diffeomorphism Groups of the Circle F Bien Path Space Realization of the Basic Representation of An 1 E Date et al Boson Fermion Correspondence Over C De Concini et al Classification of Modular Invariant Representations of Affine Algebras V G Kac M Wakimoto Standard Monomial Theory for SL2 V Lakshmibai C S Seshadri Some Results on Modular Invariant Representations S Lu Current Algebras in 3 1 Space Time Dimensions J Mickelson Standard Representations of An 1 M Primc Representations of the Algebra Uq sI 2 q Orthogonal Polynomials and Invariants of Links A N Kirillov N Yu Reshetikhin Infinite Super Grassmannians and Super Pl cker Equations M J Bergvelt Drinfeld Sokolov Hierarchies and t Functions H J Imbens Super Boson Fermion Correspondence of Type B V G Kac J W van de Leur Prym Varieties and Soliton Equations T Shiota Polynomial Solutions of the BKP Hierarchy and Projective Representations of Symmetric Groups Y You Toward Generalized Macdonald s Identities D Bernard Conformal Theories with Non Linearly Extended Virasoro Symmetries and Lie Algebra Classification A Bilal J LGervais Extended Conformal Algebras from Kac Moody Algebras P Bouwknegt Meromorphic Conformal Field Theory P Goddard Local Extensions of the U 1 Current Algebra and Their Positive Energy Representations R R Paunov I T Todorov Conformal Field Theory on Moduli Family of Stable Curves with Gauge Symmetries A Tsuchiya Y Yamada Readership Mathematicians and mathematical physicists   **Renormalization, Singular Currents and Representations of Infinite Dimensional Groups on Quantized Fields** Jan Pedersen,1991   **Kac-Moody Groups, their Flag Varieties and Representation Theory** Shrawan Kumar,2012-12-06 Kac Moody Lie algebras 9 were introduced in the mid 1960s independently by V Kac and R Moody generalizing the finite dimensional semisimple Lie alge bras which we refer to as the finite case The theory has undergone tremendous developments in various directions and connections with diverse areas abound including mathematical physics so much so that this theory has become a stan dard tool in mathematics A detailed treatment of the Lie algebra aspect of the theory can be found in V Kac s book Kac 90l This self contained work treats the algebro geometric and the topological aspects of Kac Moody theory from scratch The emphasis is on the study of the Kac Moody groups 9 and their flag varieties XY including their detailed construction and their applications to the representation theory of g In the finite case 9 is nothing but a semisimple Y simply connected algebraic group and X is the flag variety 9 Py for a parabolic subgroup p y C g   Group Theoretical Methods in Physics M. A. Markov,A. E. Shabad,1985

Representations Of Infinite Dimensional Groups Book Review: Unveiling the Magic of Language

In a digital era where connections and knowledge reign supreme, the enchanting power of language has be apparent than ever. Its ability to stir emotions, provoke thought, and instigate transformation is actually remarkable. This extraordinary book, aptly titled "**Representations Of Infinite Dimensional Groups**," compiled by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we will delve to the book is central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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