Maximum Principles On Riemannian Manifolds And Applications

This book provides a comprehensive introduction to Submanifold theory, focusing on general properties of isometric and conformal immersions of Riemannian manifolds into space forms. One main theme is the isometric and conformal deformation problem for submanifolds of arbitrary dimension and codimension. Several relevant classes of submanifolds are also discussed, including constant curvature submanifolds, submanifolds of nonpositive extrinsic curvature, conformally flat submanifolds and real Kaehler submanifolds. This is the first textbook to treat a substantial proportion of the material presented here. The first chapters are suitable for an introductory course on Submanifold theory for students with a basic background on Riemannian geometry. The remaining chapters could be used in a more advanced course by students aiming at initiating research on the subject, and are also intended to serve as a reference for specialists in the field.

MATRIX is Australia ' s international and residential mathematical research institute. It facilitates new collaborations and mathematical advances through intensive residential research programs, each 1-4 weeks in duration. This book is a scientific record of the eight programs held at MATRIX in 2018: - Non-Equilibrium Systems and Special Functions - Algebraic Geometry, Approximation and Optimisation - On the Frontiers of High Dimensional Computation - Month of Mathematical Biology - Dynamics, Foliations, and Geometry In Dimension 3 - Recent Trends on Nonlinear PDEs of Elliptic and Parabolic Type - Functional Data Analysis and Beyond - Geometric and Categorical Representation Theory The articles are grouped into peer-reviewed contributions and other contributions. The peer-reviewed articles present original results or reviews on a topic related to the MATRIX program; the remaining contributions are predominantly lecture notes or short articles based on talks or activities at MATRIX.

Maximum Principles and Their Applications

This book focuses on Hamilton's Ricci flow, beginning with a detailed discussion of the required aspects of differential geometry, progressing through existence and regularity theory, compactness theorems for Riemannian manifolds, and Perelman's noncollapsing results, and culminating in a detailed analysis of the evolution of curvature, where recent breakthroughs of Böhm and Wilking and Brendle and Schoen have led to a proof of the differentiable 1/4-pinching sphere theorem.

Riemannian Geometry

Submanifold Theory

Maximum Principles and Geometric Applications

The Ricci Flow: Techniques and Applications

2018 MATRIX Annals

Many problems in general relativity are essentially geometric in nature, in the sense that they can be understood in terms of Riemannian geometry and partial differential equations. This book is centered around the study of mass in general relativity using the techniques of geometric analysis. Specifically, it provides a comprehensive treatment of the positive mass theorem and closely related results, such as the Penrose inequality, drawing on a variety of tools used in this area of research, including minimal hypersurfaces, conformal geometry, inverse mean curvature flow, conformal flow, spinors and the Dirac operator, marginally outer trapped surfaces, and density theorems. This is the first time these topics have been gathered into a single place and presented with an advanced graduate student audience in mind; several dozen exercises are also included. The main prerequisite for this book is a working understanding of Riemannian geometry and basic knowledge of elliptic linear partial differential equations, with only minimal prior knowledge of physics required. The second part of the book includes a short crash course on general relativity, which provides background for the study of asymptotically flat initial data sets satisfying the dominant energy condition.

This work studies equivariant linear second order elliptic operators P on a connected noncompact manifold X with a given action of a group G . The action is assumed to be cocompact, meaning that GV=X for some compact subset V of X . The aim is to study the structure of the convex cone of all positive solutions of Pu= 0. It turns out that the set of all normalized positive solutions which are also eigenfunctions of the given G -action can be realized as a real analytic submanifold *G [0 of an appropriate topological vector space *H . When G is finitely generated, *H has finite dimension, and in nontrivial cases *G [0 is the boundary of a strictly convex body in *H. When G is nilpotent, any positive solution u can be represented as an integral with respect to some uniquely defined positive Borel measure over *G [0 . Lin and Pinchover also discuss related results for parabolic equations on X and for elliptic operators on noncompact manifolds with boundary.

Maximum principles are bedrock results in the theory of second order elliptic equations. This principle, simple enough in essence, lends itself to a quite remarkable number of subtle uses when combined appropriately with other notions. Intended for a wide audience, the book provides a clear and comprehensive explanation of the various maximum principles available in elliptic theory, from their beginning for linear equations to recent work on nonlinear and singular equations.

This monograph describes some of the most interesting results obtained by the mathematicians and physicists collaborating in the CRC 647 "Space – Time – Matter", in the years 2005 - 2016. The work presented concerns the mathematical and physical foundations of string and quantum field theory as well as cosmology. Important topics are the spaces and metrics modelling the geometry of matter, and the evolution of these geometries. The partial differential equations governing such structures and their singularities, special solutions and stability properties are discussed in detail. Contents Introduction Algebraic K-theory, assembly maps, controlled algebra, and trace methods Lorentzian manifolds with special holonomy – Constructions and global properties Contributions to the spectral geometry of locally homogeneous spaces On conformally covariant differential operators and spectral theory of the holographic Laplacian Moduli and deformations Vector bundles in algebraic geometry and mathematical physics Dyson – Schwinger equations: Fix-point equations for quantum fields Hidden structure in the form factors ofN = 4 SYM On regulating the AdS superstring Constraints on CFT observables from the bootstrap program Simplifying amplitudes in Maxwell-Einstein and Yang-Mills-Einstein supergravities Yangian symmetry in maximally supersymmetric Yang-Mills theory Wave and Dirac equations on manifolds Geometric analysis on singular spaces Singularities and long-time behavior in nonlinear evolution equations and general relativity

Harmonic, Quasiharmonic and Biharmonic Functions

Nonlinear Analysis on Manifolds. Monge-Amp è re Equations

Analytic and Geometric Structures

Space – Time – Matter

Wuhan, China, 18-23 October 2004

This book presents research on the latest developments in differential geometry of lightlike (degenerate) subspaces. The main focus is on hypersurfaces and a variety of submanifolds of indefinite Kählerian, Sasakian and quaternion Kähler manifolds.

Integral geometry, known as geometric probability in the past, originated from Buffon's needle experiment. Remarkable advances have been made in several areas that involve the theory of convex bodies. This volume brings together contributions by leading international researchers in integral geometry, convex geometry, complex geometry, probability, statistics, and other convexity related branches. The articles cover both recent results and exciting directions for future research.

This volume collects contributions from the speakers at an INdAM Intensive period held at the University of Bari in 2017. The contributions cover several aspects of partial differential equations whose development in recent years has experienced major breakthroughs in terms of both theory and applications. The topics covered include nonlocal equations, elliptic equations and systems, fully nonlinear equations, nonlinear parabolic equations, overdetermined boundary value problems, maximum principles, geometric analysis, control theory, mean field games, and bio-mathematics. The authors are trailblazers in these topics and present their work in a way that is exhaustive and clearly accessible to PhD students and early career researcher. As such, the book offers an excellent introduction to a variety of fundamental topics of contemporary investigation and inspires novel and high-quality research.

This monograph presents an introduction to some geometric and analytic aspects of the maximum principle. In doing so, it analyses with great detail the mathematical tools and geometric foundations needed to develop the various new forms that are presented in the first chapters of the book. In particular, a generalization of the Omori-Yau maximum principle to a wide class of differential operators is given, as well as a corresponding weak maximum principle and its equivalent open form and parabolicity as a special stronger formulation of the latter. In the second part, the attention focuses on a wide range of applications, mainly to geometric problems, but also on some analytic (especially PDEs) questions including: the geometry of submanifolds, hypersurfaces in Riemannian and Lorentzian targets, Ricci solitons, Liouville theorems, uniqueness of solutions of Lichnerowicz-type PDEs and so on. Maximum Principles and Geometric Applications is written in an easy style making it accessible to beginners. The reader is guided with a detailed presentation of some topics of Riemannian geometry that are usually not covered in textbooks. Furthermore, many of the results and even proofs of known results are new and lead to the frontiers of a contemporary and active field of research.

Geometric Analysis of Quasilinear Inequalities on Complete Manifolds

Elliptic and Parabolic Equations

Partial Differential Equations And Their Applications - Proceedings Of The Conference

Maximum and Comparison Principles at Infinity on Riemannian Manifolds

U.S. Government Research & Development Reports

This volume is an English translation of Sakai's textbook on Riemannian Geometry which was originally written in Japanese and published in 1992. The author's intent behind the original book was to provide to advanced undergraduate and graudate students an introduction to modern Riemannian geometry that could also serve as a reference. The book begins with an explanation of the fundamental notion of Riemannian geometry. Special emphasis is placed on understandability and readability, to guide students who are new to this area. The remaining chapters deal with various topics in Riemannian geometry, with the main focus on comparison methods and their applications.

A collection of self contained state-of-the art surveys. The authors have made an effort to achieve readability for mathematicians and scientists from other fields, for this series of handbooks to be a new reference for research, learning and teaching. - written by well-known experts in the field - self contained volume in series covering one of the most rapid developing topics in mathematics

This volume reports the recent progress in linear and nonlinear partial differential equations, microlocal analysis, singular partial differential operators, spectral analysis and hyperfunction theory.

Einstein's equations stem from General Relativity. In the context of Riemannian manifolds, an independent mathematical theory has developed around them. This is the first book

which presents an overview of several striking results ensuing from the examination of Einstein's equations in the context of Riemannian manifolds. Parts of the text can be used as an introduction to modern Riemannian geometry through topics like homogeneous spaces, submersions, or Riemannian functionals.
Revista Matemática Iberoamericana
The Ricci Flow in Riemannian Geometry
Eigenfunctions of the Laplacian on a Riemannian Manifold

The Maximum Principle and the Dirichlet Problem for Dirac-harmonic Maps
All papers appearing in this volume are original research articles and have not been published elsewhere. They meet the requirements that are necessary for publication in a good quality primary journal. E.Belchev, S.Hineva: On the minimal hypersurfaces of a locally symmetric manifold. -N.Blasic, N.Bokan, P.Gilkey: The spectral geometry of the Laplacian and the conformal Laplacian for manifolds with boundary. -J.Bolton, W.M.Oxbury, L.Vrancken, L.M. Woodward: Minimal immersions of RP2 into CPn. -W.Cieslak, A. Miernowski, W.Mozgawa: Isoptics of a strictly convex curve. -F.Dillen, L.Vrancken: Generalized Cayley surfaces. -A.Ferrandez, O.J.Garay, P.Lucas: On a certain class of conformally flat Euclidean hypersurfaces. -P.Gauduchon: Self-dual manifolds with non-negative Ricci operator. -B.Hajduk: On the obstruction group toexistence of Riemannian metrics of positive scalar curvature. -U.Hammenstaedt: Compact manifolds with 1/4-pinched negative curvature. -J.Jost, Xiaowei Peng: The geometry of moduli spaces of stable vector bundles over Riemannian surfaces. - O.Kowalski, F.Tricerri: A canonical connection for locally homogeneous Riemannian manifolds. -M.Kozlowski: Some improper affine spheres in A3. -R.Kusner: A maximum principle at infinity and the topology of complete embedded surfaces with constant mean curvature. -Anmin Li: Affine completeness and Euclidean completeness. -U.Lumiste: On submanifolds with parallel higher order fundamental form in Euclidean spaces. -A.Martinez, F.Milan: Convex affine surfaces with constant affine mean curvature. -M.Min-Oo, E.A.Ruh, P.Tondeur: Transversal curvature and tautness for Riemannian foliations. -S.Montiel, A.Ros: Schroedinger operators associated to a holomorphic map. -D.Motreanu: Generic existence of Morse functions on infinite dimensional Riemannian manifolds and applications. -B.Opozda: Some extensions of Radon's theorem.
This book illustrates the wide range of research subjects developed by the Italian research group in harmonic analysis, originally started by Alessandro Figà-Talamanca, to whom it is dedicated in the occasion of his retirement. In particular, it outlines some of the impressive ramifications of the mathematical developments that began when Figà-Talamanca brought the study of harmonic analysis to Italy; the research group that he nurtured has now expanded to cover many areas. Therefore the book is addressed not only to experts in harmonic analysis, summability of Fourier series and singular integrals, but also in potential theory, symmetric spaces, analysis and partial differential equations on Riemannian manifolds, analysis on graphs, trees, buildings and discrete groups, Lie groups and Lie algebras, and even in far-reaching applications as for instance cellular automata and signal processing (low-discrepancy sampling, Gaussian noise).
Stochastic analysis on Riemannian manifolds without boundary has been well established. However, the analysis for reflecting diffusion processes and sub-elliptic diffusion processes is far from complete. This book contains recent advances in this direction along with new ideas and efficient arguments, which are crucial for further developments. Many results contained here (for example, the formula of the curvature using derivatives of the semigroup) are new among existing monographs even in the case without boundary. Contents:PreliminariesDiffusion Processes on Riemannian Manifolds without BoundaryReflecting Diffusion Processes on Manifolds with BoundaryStochastic Analysis on Path Space over Manifolds with BoundarySubelliptic Diffusion Processes Readership: Graduate students, researchers and professionals in probability theory, differential geometry and partial differential equations. Keywords:Diffusion Pocess;Reflecting Diffusion Process;Neumann Semigroup;Curvature;Second Fundamental Form;ManifoldKey Features:First book where the key theory and machinery of the reflecting diffusion processes on Riemannian manifolds with boundary are systematically introducedFirst book to clarify intrinsic links between the semigroup properties on one hand and geometric quantities (curvature and second fundamental form) on the other, and these links are introduced in an easy to understand manner: by formulating geometric quantities using short time behaviors of derivatives of the semigroup, whereby a reader can easily comprehend the equivalence of semigroup properties associated with lower bounds of these geometric quantitiesFirst book where stochastic analysis on Riemannian manifolds with boundary are introduced
This volume is intended to allow mathematicians and physicists, especially analysts, to learn about nonlinear problems which arise in Riemannian Geometry. Analysis on Riemannian manifolds is a field currently undergoing great development. More and more, analysis proves to be a very powerful means for solving geometrical problems. Conversely, geometry may help us to solve certain problems in analysis. There are several reasons why the topic is difficult and interesting. It is very large and almost unexplored. On the other hand, geometric problems often lead to limiting cases of known problems in analysis, sometimes there is even more than one approach, and the already existing theoretical studies are inadequate to solve them. Each problem has its own particular difficulties. Nevertheless there exist some standard methods which are useful and which we must know to apply them. One should not forget that our problems are motivated by geometry, and that a geometrical argument may simplify the problem under investigation. Examples of this kind are still too rare. This work is neither a systematic study of a mathematical field nor the presentation of a lot of theoretical knowledge. On the contrary, I do my best to limit the text to the essential knowledge. I define as few concepts as possible and give only basic theorems which are useful for our topic. But I

hope that the reader will find this sufficient to solve other geometrical problems by analysis.
Contemporary Research in Elliptic PDEs and Related Topics
Handbook of Differential Equations: Stationary Partial Differential Equations
Differential Geometry of Lightlike Submanifolds
Extrinsic Geometric Flows
An Introduction

The aim of this paper is to introduce the reader to various forms of the maximum principle, starting from its classical formulation up to generalizations of the Omori-Yau maximum principle at infinity recently obtained by the authors. Applications are given to a number of geometrical problems in the setting of complete Riemannian manifolds, under assumptions either on the curvature or on the volume growth of geodesic balls.

This is the first account in book form of the theory of harmonic morphisms between Riemannian manifolds. Harmonic morphisms are maps which preserve Laplace's equation. They can be characterized as harmonic maps which satisfy an additional first order condition. Examples include harmonic functions, conformal mappings in the plane, and holomorphic functions with values in a Riemann surface. There are connections with many concepts in differential geometry, for example, Killing fields, geodesics, foliations, Clifford systems, twistor spaces, Hermitian structures, iso-parametric mappings, and Einstein metrics and also the Brownain pathpreserving maps of probability theory. Giving a complete account of the fundamental aspects of the subject, this book is self-contained, assuming only a basic knowledge of differential geometry.

We establish a maximum principle and uniqueness for Dirac-harmonic maps from a Riemannian spin manifold with boundary into a regular ball in any Riemannian manifold N. Then we prove an existence theorem for a boundary value problem for Dirac-harmonic maps.

Maximum Principles on Riemannian Manifolds and ApplicationsAmerican Mathematical Soc.
The Maximum Principle
Einstein Manifolds
Bulletin of the Korean Mathematical Society
Analysis for Diffusion Processes on Riemannian Manifolds
Harmonic Morphisms Between Riemannian Manifolds

This book demonstrates the influence of geometry on the qualitative behaviour of solutions of quasilinear PDEs on Riemannian manifolds. Motivated by examples arising, among others, from the theory of submanifolds, the authors study classes of coercive elliptic differential inequalities on domains of a manifold M with very general nonlinearities depending on the variable x, on the solution u and on its gradient. The book highlights the mean curvature operator and its variants, and investigates the validity of strong maximum principles, compact support principles and Liouville type theorems. In particular, it identifies sharp thresholds involving curvatures or volume growth of geodesic balls in M to guarantee the above properties under appropriate Keller-Osserman type conditions, which are investigated in detail throughout the book, and discusses the geometric reasons behind the existence of such thresholds. Further, the book also provides a unified review of recent results in the literature, and creates a bridge with geometry by studying the validity of weak and strong maximum principles at infinity, in the spirit of Omori-Yau’s Hessian and Laplacian principles and subsequent improvements.

The international workshop on which this proceedings volume is based on brought together leading researchers in the field of elliptic and parabolic equations. Particular emphasis was put on the interaction between well-established scientists and emerging young mathematicians, as well as on exploring new connections between pure and applied mathematics. The volume contains material derived after the workshop taking up the impetus to continue collaboration and to incorporate additional new results and insights.

Eigenfunctions of the Laplacian of a Riemannian manifold can be described in terms of vibrating membranes as well as quantum energy eigenstates. This book is an introduction to both the local and global analysis of eigenfunctions. The local analysis of eigenfunctions pertains to the behavior of the eigenfunctions on wavelength scale balls. After re-scaling to a unit ball, the eigenfunctions resemble almost-harmonic functions. Global analysis refers to the use of wave equation methods to relate properties of eigenfunctions to properties of the geodesic flow. The emphasis is on the global methods and the use of Fourier integral operator methods to analyze norms and nodal sets of eigenfunctions. A somewhat unusual topic is the analytic continuation of eigenfunctions to Grauert tubes in the real analytic case, and the study of nodal sets in the complex domain. The book, which grew out of lectures given by the author at a CBMS conference in 2011, provides complete proofs of some model results, but more often it gives informal and intuitive explanations of proofs of fairly recent results. It conveys inter-related themes and results and offers an up-to-date comprehensive treatment of this important active area of research.

The subject matter in this volume is Schwarz's lemma which has become a crucial theme in many branches of research in mathematics for more than

a hundred years to date. This volume of lecture notes focuses on its differential geometric developments by several excellent authors including, but not limited to, L Ahlfors, S S Chern, Y C Lu, S T Yau and H L Royden. This volume can be approached by a reader who has basic knowledge on complex analysis and Riemannian geometry. It contains major historic differential geometric generalizations on Schwarz's lemma and provides the necessary information while making the whole volume as concise as ever.

Global Differential Geometry and Global Analysis

Integral Geometry and Convexity

Trends in Harmonic Analysis

Generalized Ricci Flow

Proceedings of the International Conference Integral Geometry and Convexity

Extrinsic geometric flows are characterized by a submanifold evolving in an ambient space with velocity determined by its extrinsic curvature. The goal of this book is to give an extensive introduction to a few of the most prominent extrinsic flows, namely, the curve shortening flow, the mean curvature flow, the Gauß curvature flow, the inverse-mean curvature flow, and fully nonlinear flows of mean curvature and inverse-mean curvature type. The authors highlight techniques and behaviors that frequently arise in the study of these (and other) flows. To illustrate the broad applicability of the techniques developed, they also consider general classes of fully nonlinear curvature flows. The book is written at the level of a graduate student who has had a basic course in differential geometry and has some familiarity with partial differential equations. It is intended also to be useful as a reference for specialists. In general, the authors provide detailed proofs, although for some more specialized results they may only present the main ideas; in such cases, they provide references for complete proofs. A brief survey of additional topics, with extensive references, can be found in the notes and commentary at the end of each chapter.

The Ricci flow is a powerful technique that integrates geometry, topology, and analysis. Intuitively, the idea is to set up a PDE that evolves a metric according to its Ricci curvature. The resulting equation has much in common with the heat equation, which tends to 'flow' a given function to ever nicer functions. By analogy, the Ricci flow evolves an initial metric into improved metrics. Richard Hamilton began the systematic use of the Ricci flow in the early 1980s and applied it in particular to study 3-manifolds. Grisha Perelman has made recent breakthroughs aimed at completing Hamilton's program. The Ricci flow method is now central to our understanding of the geometry and topology of manifolds.This book is an introduction to that program and to its connection to Thurston's geometrization conjecture. The authors also provide a 'Guide for the hurried reader', to help readers wishing to develop, as efficiently as possible, a nontechnical appreciation of the Ricci flow program for 3-manifolds, i.e., the so-called 'fast track'. The book is suitable for geometers and others who are interested in the use of geometric analysis to study the structure of manifolds. ""The Ricci Flow"" was nominated for the 2005 Robert W. Hamilton Book Award, which is the highest honor of literary achievement given to published authors at the University of Texas at Austin.

The generalized Ricci flow is a geometric evolution equation which has recently emerged from investigations into mathematical physics, Hitchin's generalized geometry program, and complex geometry. This book gives an introduction to this new area, discusses recent developments, and formulates open questions and conjectures for future study. The text begins with an introduction to fundamental aspects of generalized Riemannian, complex, and Kähler geometry. This leads to an extension of the classical Einstein-Hilbert action, which yields natural extensions of Einstein and Calabi-Yau structures as 'canonical metrics' in generalized Riemannian and complex geometry. The book then introduces generalized Ricci flow as a tool for constructing such metrics and proves extensions of the fundamental Hamilton/Perelman regularity theory of Ricci flow. These results are refined in the setting of generalized complex geometry, where the generalized Ricci flow is shown to preserve various integrability conditions, taking the form of pluriclosed flow and generalized Kähler-Ricci flow, leading to global convergence results and applications to complex geometry. Finally, the book gives a purely mathematical introduction to the physical idea of T-duality and discusses its relationship to generalized Ricci flow. The book is suitable for graduate students and researchers with a background in Riemannian and complex geometry who are interested in the theory of geometric evolution equations.

A geometric maximum principle for surfaces of prescribed mean curvature in Riemannian manifolds

Maximum Principles on Riemannian Manifolds and Applications

Schwarz's Lemma from a Differential Geometric Viewpoint

A Complete Proof of the Differentiable 1/4-Pinching Sphere Theorem

Manifolds with Group Actions and Elliptic Operators