Differential Geometry And Relativity A Volume In Honour Of Andri 1 2 Lichnerowicz On His 60th Birthday Mathematical Physics And Applied Mathematics

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Differential Geometry and Mathematical Physics - John K. Beem 1994
This book contains the proceedings of the Special Session, Geometric Methods in Mathematical Physics, held at the joint AMS-CMS meeting in Vancouver in August 1993. The papers collected here contain a number of new results in differential geometry and its applications to physics. The major themes include black holes, singularities, censorship, the Einstein field equations, geodesics, index theory, submanifolds, CR-structures, and space-time symmetries. In addition, there are papers on Yang-Mills fields, geometric techniques in control theory, and equilibria. Containing new results by established researchers in the field, this book provides a look at developments in this exciting area of research.

The Geometry of Physics - Theodore Frankel 2011-11-03
This book provides a working knowledge of those parts of exterior differential forms, differential geometry, algebraic and differential topology, Lie groups, vector bundles and Chern forms that are essential for a deeper understanding of both classical and modern physics and engineering. Included are discussions of analytical and fluid dynamics, electromagnetism (in flat and curved space), thermodynamics, the Dirac operator and spinors, and gauge fields, including Yang–Mills, the Aharonov–Bohm effect, Berry phase and instanton winding numbers, quarks and quark model for mesons. Before discussing abstract notions of differential geometry, geometric intuition is developed through a rather extensive introduction to the study of surfaces in ordinary space. The book is ideal for graduate and advanced undergraduate students of physics, engineering or mathematics as a course text or for self study. This third edition includes an overview of Cartan's exterior differential forms, which previews many of the geometric concepts developed in the text.

Advances in Differential Geometry and General Relativity - John K. Beem 2004
This volume consists of expanded versions of invited lectures given at The Beemfest: Advances in Differential Geometry and General Relativity (University of Missouri-Columbia) on the occasion of Professor John K. Beem's retirement. The articles address problems in differential geometry in general and in particular, global Lorentzian geometry, Finsler geometry, causal boundaries, Penrose's cosmic censorship hypothesis, the geometry of differential operators with variable coefficients on manifolds, and asymptotically de Sitter spacetimes satisfying Einstein's equations with positive cosmological constant. The book is

suitable for graduate students and research mathematicians interested in differential geometry.

Manifolds, Tensors and Forms - Paul Renteln 2014

Comprehensive treatment of the essentials of modern differential geometry and topology for graduate students in mathematics and the physical sciences.

Problems and Solutions in Differential Geometry, Lie Series, Differential Forms, Relativity and Applications - Willi-Hans Steeb 2017-10-20

This volume presents a collection of problems and solutions in differential geometry with applications. Both introductory and advanced topics are introduced in an easy-to-digest manner, with the materials of the volume being self-contained. In particular, curves, surfaces, Riemannian and pseudo-Riemannian manifolds, Hodge duality operator, vector fields and Lie series, differential forms, matrix-valued differential forms, Maurer–Cartan form, and the Lie derivative are covered. Readers will find useful applications to special and general relativity, Yang–Mills theory, hydrodynamics and field theory. Besides the solved problems, each chapter contains stimulating supplementary problems and software implementations are also included. The volume will not only benefit students in mathematics, applied mathematics and theoretical physics, but also researchers in the field of differential geometry. Request Inspection Copy

Differential Sheaves And Connections: A Natural Approach To Physical Geometry - Mallios Anastasios 2015-09-17

This unique book provides a self-contained conceptual and technical introduction to the theory of differential sheaves. This serves both the newcomer and the experienced researcher in undertaking a background-independent, natural and relational approach to 'physical geometry'. In this manner, this book is situated at the crossroads between the foundations of mathematical analysis with a view toward differential geometry and the foundations of theoretical physics with a view toward quantum mechanics and quantum gravity. The unifying thread is provided by the theory of adjoint functors in category theory and the elucidation of the concepts of sheaf theory and homological algebra in relation to the description and analysis of dynamically constituted physical geometric spectrums.

Applicable Differential Geometry - Mike Crampin 1986

An introduction to geometrical topics used in applied mathematics and theoretical physics.

Modern Differential Geometry for Physicists - Chris J. Isham 2002

Global Differential Geometry - Alfred Gray 2001

Alfred Gray's work covered a great part of differential geometry. In September 2000, a remarkable International Congress on Differential Geometry was held in his memory in Bilbao, Spain. Mathematicians from all over the world, representing 24 countries, attended the event. This volume includes major contributions by well known mathematicians (T. Banchoff, S. Donaldson, H. Ferguson, M. Gromov, N. Hitchin, A. Huckleberry, O. Kowalski, V. Miquel, E. Musso, A. Ros, S. Salamon, L. Vanhecke, P. Wellin and J.A. Wolf), the interesting discussion from the round table moderated by J.-P. Bourguignon, and a carefully selected and refereed selection of the Short Communications presented at the Congress.This book represents the state of the art in modern differential geometry, with some general expositions of some of the more active areas: special Riemannian manifolds, Lie groups and homogeneous spaces, complex structures, symplectic manifolds, geometry of geodesic spheres and tubes and related problems, geometry of surfaces, and computer graphics in differential geometry.

Semi-Riemannian Geometry - Stephen C. Newman 2019-07-30

An introduction to semi-Riemannian geometry as a foundation for general relativity Semi-Riemannian Geometry: The Mathematical Language of General Relativity is an accessible exposition of the mathematics underlying general relativity. The book begins with background on linear and multilinear algebra, general topology, and real analysis. This is followed by material on the classical theory of curves and surfaces, expanded to include both the Lorentz and Euclidean signatures. The remainder of the book is devoted to a discussion of smooth manifolds, smooth manifolds with boundary, smooth manifolds with a connection, semi-Riemannian manifolds, and differential operators, culminating in applications to Maxwell's equations and the Einstein tensor. Many worked examples and detailed diagrams are provided to aid understanding. This book will appeal especially to physics students wishing to learn more differential geometry than is usually provided in texts on general relativity.

The Theory of Quantum Torus Knots - Michael Ungs 2009-11-06

A detailed mathematical derivation of space curves is presented that links the diverse fields of superfluids, quantum mechanics, and hydrodynamics by a common foundation. The basic mathematical building block is called the theory of quantum torus knots (QTK).

From Riemann to Differential Geometry and Relativity - Lizhen Ji 2017-10-03

This book explores the work of Bernhard Riemann and its impact on mathematics, philosophy and physics. It features contributions from a range of fields, historical expositions, and selected research articles that were motivated by Riemann's ideas and demonstrate their timelessness. The editors are convinced of the tremendous value of going into Riemann's work in depth, investigating his original ideas, integrating them into a broader perspective, and establishing ties with modern science and philosophy. Accordingly, the contributors to this volume are mathematicians, physicists, philosophers and historians of science. The book offers a unique resource for students and researchers in the fields of mathematics, physics and philosophy, historians of science, and more generally to a wide range of readers interested in the history of ideas.

Finsler Geometry, Relativity and Gauge Theories - G.S. Asanov 2012-12-06

The methods of differential geometry have been so completely merged nowadays with physical concepts that general relativity may well be considered to be a physical theory of the geometrical properties of space-time. The general relativity principles together with the recent development of Finsler geometry as a metric generalization of Riemannian geometry justify the attempt to systematize the basic techniques for extending general relativity on the basis of Finsler geometry. It is this endeavour that forms the subject matter of the present book. Our exposition reveals the remarkable fact that the Finslerian approach is automatically permeated with the idea of the unification of the geometrical space-time picture with gauge field theory - a circumstance that we try our best to elucidate in this book. The book has been written in such a way that the reader acquainted with the methods of tensor calculus and linear algebra at the graduate level can use it as a manual of Finslerian techniques orientable to applications in several fields. The problems attached to the chapters are also intended to serve this purpose. This notwithstanding, whenever we touch upon the Finslerian refinement or generalization of physical concepts, we assume that the reader is acquainted with these concepts at least at the level of the standard textbooks, to which we refer him or her.

Differential Geometry Of Warped Product Manifolds And Submanifolds - Chen Bang-yen 2017-05-29

A warped product manifold is a Riemannian or pseudo-Riemannian manifold whose metric tensor can be decomposed into a Cartesian product of the y geometry and the x geometry — except that the x-part is warped, that is, it is rescaled by a scalar function of the other coordinates y. The notion of warped product manifolds plays very important roles not only in geometry but also in mathematical physics, especially in general relativity. In fact, many basic solutions of the Einstein field equations, including the Schwarzschild solution and the Robertson–Walker models, are warped product manifolds. The first part of this volume provides a self-contained and accessible introduction to the important subject of pseudo-Riemannian manifolds and submanifolds. The second part presents a detailed and up-to-date account on important results of warped product manifolds, including several important spacetimes such as Robertson–Walker's and Schwarzschild's. The famous John Nash's embedding theorem published in 1956 implies that every warped product manifold can be realized as a warped product submanifold in a suitable Euclidean space. The study of warped product submanifolds in various important ambient spaces from an extrinsic point of view was initiated by the author around the beginning of this century. The last part of this volume contains an extensive and comprehensive survey of numerous important results on the geometry of warped product submanifolds done during this century by many geometers.

Techniques of Differential Topology in Relativity - Roger Penrose 1972-01-01

Acquaints the specialist in relativity theory with some global techniques for the treatment of space-times and will provide the pure mathematician with a way into the subject of general relativity.

Differential Geometry and Relativity Theory - RichardL. Faber 2017-10-19

Differentilil Geometry and Relativity Theory: An Introduction approaches relativity asa geometric theory of space and time in which gravity is a manifestation of space-timecurvature, rathe1 than a force. Uniting differential geometry and both special and generalrelativity in a single source, this easy-to-understand text opens the general theory of relativityto mathematics majors having a backgr.ound only in multivariable calculus and linearalgebra.The book offers a broad overview of the physical foundations and mathematical details ofrelativity, and presents concrete physical interpretations of numerous abstract concepts inRiemannian geometry. The work is profusely illustrated with diagrams aiding in the understandingof proofs and explanations. Appendices feature important material on vectoranalysis and hyperbolic functions.Differential Geometry and Relativity Theory: An Introduction serves as the ideal textfor high-level undergraduate couues in mathematics and physics, and includes a solutionsmanual augmenting classroom study. It is an invaluable reference for mathematicians interestedin differential and IUemannian geometry, or the special and general theories ofrelativity

Relativity and Geometry - Roberto Torretti 2014-05-20

Relativity and Geometry aims to elucidate the motivation and significance of the changes in physical geometry brought about by Einstein, in both the first and the second phases of relativity. The book contains seven chapters and a mathematical appendix. The first two chapters review a historical background of relativity. Chapter 3 centers on Einstein's first Relativity paper of 1905. Subsequent chapter presents the Minkowskian formulation of special relativity. Chapters 5 and 6 deal with Einstein's search for general relativity from 1907 to 1915, as well as some aspects and subsequent developments of the theory. The last chapter explores the concept of simultaneity, geometric conventionalism, and a few other questions concerning space time structure, causality, and time.

Lorentzian Geometry and Related Topics - María A. Cañadas-Pinedo 2018-03-06

This volume contains a collection of research papers and useful surveys by experts in the field which provide a representative picture of the current status of this fascinating area. Based on contributions from the VIII International Meeting on Lorentzian Geometry, held at the University of Málaga, Spain, this volume covers topics such as distinguished (maximal, trapped, null, spacelike, constant mean curvature, umbilical...) submanifolds, causal completion of spacetimes, stationary regions and horizons in spacetimes, solitons in semi-Riemannian manifolds, relation between Lorentzian and Finslerian geometries and the oscillator spacetime. In the last decades Lorentzian geometry has experienced a significant impulse, which has transformed it from just a mathematical tool for general relativity to a consolidated branch of differential geometry, interesting in and of itself. Nowadays, this field provides a framework where many different mathematical techniques arise with applications to multiple parts of mathematics and physics. This book is addressed to differential geometers, mathematical physicists and relativists, and graduate students interested in the field.

Differential Geometry and Relativity - M. Cahen 2012-12-06

On the occasion of the sixtieth birthday of Andre Lichnerowicz a number of his friends, many of whom have been his students or coworkers, decided to celebrate this event by preparing a jubilee volume of contributed articles in the two main fields of research marked by Lichnerowicz's work, namely differential geometry and mathematical physics. Limitations of space and time did not enable us to include papers from all Lichnerowicz's friends nor from all his former students. It was equally impossible to reflect in a single book the great variety of subjects tackled by Lichnerowicz. In spite of these limitations, we hope that this book reflects some of the present trends of fields in which he worked, and some of the subjects to which he contributed in his long - and not yet finished - career. This career was very much marked by the influence of his masters, Elie Cartan who introduced him to research in mathematics, mainly in geometry and its relations with mathematical physics, and Georges Darmois who developed his interest for mechanics and physics, especially the theory of relativity and electromagnetism. This par ticular combination, and his personal talent, made of him a natural scientific heir and continuator of the French mathematical physics school in the tradition of Henri Poincare. Some of his works would even be best qualified by a new field name, that of physical ma thematics: branches of pure mathematics entirely motivated by physics.

Differential Geometry of Manifolds - Stephen Lovett 2019-12-16

Differential Geometry of Manifolds, Second Edition presents the extension of differential geometry from curves and surfaces to manifolds in general. The book provides a broad introduction to the field of differentiable and Riemannian manifolds, tying together classical and modern formulations. It introduces manifolds in a both streamlined and mathematically rigorous way while keeping a view toward applications, particularly in physics. The author takes a practical approach, containing extensive exercises and focusing on applications, including the Hamiltonian formulations of mechanics, electromagnetism, string theory. The Second Edition of this successful textbook offers several notable points of revision. New to the Second Edition: New problems have been added and the level of challenge has been changed to the exercises Each section corresponds to a 60-minute lecture period, making it more user-friendly for lecturers Includes new sections which provide more comprehensive coverage of topics Features a new chapter on Multilinear Algebra

Differential Geometry, Calabi-Yau Theory, and General Relativity - Huai-Dong Cao 2018

Modern Differential Geometry in Gauge Theories - Anastasios Mallios 2009-10-22

Original, well-written work of interest Presents for the first time (physical) field theories written in sheaf-theoretic language Contains a wealth of minutely detailed, rigorous computations, ususally absent from standard physical treatments Author's mastery of the subject and the rigorous treatment of this text make it invaluable

General Relativity for Mathematicians - R.K. Sachs 2012-12-06

This is a book about physics, written for mathematicians. The readers we have in mind can be roughly described as those who: I. are mathematics graduate students with some knowledge of global differential geometry 2. have had the equivalent of freshman physics, and find popular accounts of astrophysics and cosmology interesting 3. appreciate mathematical elarity, but are willing to accept physical motiva tions for the mathematics in place of mathematical ones 4. are willing to spend time and effort mastering certain technical details, such as those in Section 1. 1. Each book disappoints so me readers. This one will disappoint: 1. physicists who want to use this book as a first course on differential geometry 2. mathematicians who think Lorentzian manifolds are wholly similar to Riemannian ones, or that, given a sufficiently good mathematical back ground, the essentials of a subject !ike cosmology can be learned without so me hard work on boring detaiis 3. those who believe vague philosophical arguments have more than historical and heuristic significance, that general relativity should somehow be "proved," or that axiomatization of this subject is useful 4. those who want an encyclopedic treatment (the books by Hawking-Ellis [1], Penrose [1], Weinberg [1], and Misner-Thorne-Wheeler [I] go further into the subject than we do; see also the survey article, Sachs-Wu [1]). 5. mathematicians who want to learn quantum physics or unified fieId theory (unfortunateIy, quantum physics texts all seem either to be for physicists, or merely concerned with formaI mathematics).

Geometric Relativity - Dan A. Lee 2019-09-25

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.

Differential Geometry and Mathematical Physics - Gerd Rudolph 2012-11-09

Starting from an undergraduate level, this book systematically develops the basics of • Calculus on manifolds, vector bundles, vector fields and differential forms, • Lie groups and Lie group actions, • Linear symplectic algebra and symplectic geometry, • Hamiltonian systems, symmetries and reduction, integrable systems and Hamilton-Jacobi theory. The topics listed under the first item are relevant for virtually all areas of mathematical physics. The second and third items constitute the link between abstract calculus and the theory of Hamiltonian systems. The last item provides an introduction to various aspects of this theory, including Morse families, the Maslov class and caustics. The book guides the reader from elementary differential geometry to advanced topics in the theory of Hamiltonian systems with the aim of making current research literature accessible. The style is that of a mathematical textbook,with full proofs given in the text or as exercises. The material is illustrated by numerous detailed examples, some of which are taken up several times for demonstrating how the methods evolve and interact.

Handbook of Differential Geometry - F.J.E. Dillen 1999-12-16

In the series of volumes which together will constitute the Handbook of Differential Geometry a rather complete survey of the field of differential geometry is given. The different chapters will both deal with the basic material of differential geometry and with research results (old and recent). All chapters are written by experts in the area and contain a large bibliography.

Modern Differential Geometry in Gauge Theories - Anastasios Mallios 2005-12-14

This is original, well-written work of interest Presents for the first time (physical) field theories written in sheaf-theoretic language Contains a wealth of minutely detailed, rigorous computations, ususally absent from standard physical treatments Author's mastery of the subject and the rigorous treatment of this text make it invaluable

Differential Geometry and Relativity - M. Cahen 1976-12-31

On the sixtieth birthday of Andre Lichnerowicz a number of his friends, students, and coworkers decided to celebrate this event by preparing a jubilee volume of contributed articles in the two main fields of research marked by Lichnerowicz's work: differential geometry and mathematical physics. It was impossible to reflect in a single book the great variety of subjects tackled by Lichnerowicz. We hope that this book reflects some of the present trends of fields in which he worked, and some of the subjects to which he contributed in his long - and not yet finished - career. This career was very much marked by the influence of his masters, Elie Cartan who introduced him to research in mathematics, mainly in geometry and its relations with mathematical physics, and Georges Darmois who developed his interest in mechanics and physics, especially the theory of relativity and electromagnetism. This combination, and his personal talent, made him a natural scientific heir and continuator of the French mathematical physics school in the tradition of Henri Poincare. Some of his works would even be best qualified by a new field name, that of physical mathematics: branches of pure mathematics entirely motivated by physics.

Semi-Riemannian Geometry With Applications to Relativity - Barrett O'Neill 1983-07-29

This book is an exposition of semi-Riemannian geometry (also called pseudo-Riemannian geometry)--the study of a smooth manifold furnished with a metric tensor of arbitrary signature. The principal special cases are Riemannian geometry, where the metric is positive definite, and Lorentz geometry. For many years these two geometries have developed almost independently: Riemannian geometry reformulated in coordinate-free fashion and directed toward global problems, Lorentz geometry in classical tensor notation devoted to general relativity. More recently, this divergence has been reversed as physicists, turning increasingly toward invariant methods, have produced results of compelling mathematical interest.

Differential Forms and the Geometry of General Relativity - Tevian Dray 2014-10-20

Differential Forms and the Geometry of General Relativity provides readers with a coherent path to understanding relativity. Requiring little more than calculus and some linear algebra, it helps readers learn just enough differential geometry to grasp the basics of general relativity. The book contains two intertwined but distinct halves. Designed for advanced undergraduate or beginning graduate students in mathematics or physics, most of the text requires little more than familiarity with calculus and linear algebra. The first half presents an introduction to general relativity that describes some of the surprising implications of relativity without introducing more formalism than necessary. This nonstandard approach uses differential forms rather than tensor calculus and minimizes the use of "index gymnastics" as much as possible. The second half of the book takes a more detailed look at the mathematics of differential forms. It covers the theory behind the mathematics used in the first half by emphasizing a conceptual understanding instead of formal proofs. The book provides a language to describe curvature, the key geometric idea in general relativity.

Differential Geometry - Loring W. Tu 2017-06-01

This text presents a graduate-level introduction to differential geometry for mathematics and physics students. The exposition follows the historical development of the concepts of connection and curvature with the goal of explaining the Chern–Weil theory of characteristic classes on a principal bundle. Along the way we encounter some of the high points in the history of differential geometry, for example, Gauss' Theorema Egregium and the Gauss–Bonnet theorem. Exercises throughout the book test the reader’s understanding of the material and sometimes illustrate extensions of the theory. Initially, the prerequisites for the reader include a passing familiarity with manifolds. After the first chapter, it becomes necessary to understand and manipulate differential forms. A knowledge of de Rham cohomology is required for the last third of the text. Prerequisite material is contained in author's text An Introduction to Manifolds, and can be learned in one semester. For the benefit of the reader and to establish common notations, Appendix A recalls the basics of manifold theory. Additionally, in an attempt to make the exposition more self-contained, sections on algebraic constructions such as the tensor product and the exterior power are included. Differential geometry, as its name implies, is the study of geometry using differential calculus. It dates back to Newton and Leibniz in the seventeenth century, but it was not until the nineteenth century, with the work of Gauss on surfaces and Riemann on the curvature tensor, that differential geometry flourished and its modern foundation was laid. Over the past one hundred years, differential geometry has proven indispensable to an understanding of the physical world, in Einstein's general theory of relativity, in the theory of gravitation, in gauge theory, and now in string theory. Differential geometry is also useful in topology, several complex variables, algebraic geometry, complex manifolds, and dynamical systems, among other fields. The field has even found applications to group theory as in Gromov's work and to probability theory as in Diaconis's work. It is not too far-fetched to argue that differential geometry should be in every mathematician's arsenal.

Geometry: from Isometries to Special Relativity - Nam-Hoon Lee 2020-04-28
This textbook offers a geometric perspective on special relativity, bridging Euclidean space, hyperbolic space, and Einstein’s spacetime in one accessible, self-contained volume. Using tools tailored to undergraduates, the author explores Euclidean and non-Euclidean geometries, gradually building from intuitive to abstract spaces. By the end, readers will have encountered a range of topics, from isometries to the Lorentz–Minkowski plane, building an understanding of how geometry can be used to model special relativity. Beginning with intuitive spaces, such as the Euclidean plane and the sphere, a structure theorem for isometries is introduced that serves as a foundation for increasingly sophisticated topics, such as the hyperbolic plane and the Lorentz–Minkowski plane. By gradually introducing tools throughout, the author offers readers an accessible pathway to visualizing increasingly abstract geometric concepts. Numerous exercises are also included with selected solutions provided. Geometry: from Isometries to Special Relativity offers a unique approach to non-Euclidean geometries, culminating in a mathematical model for special relativity. The focus on isometries offers undergraduates an accessible progression from the intuitive to abstract; instructors will appreciate the complete instructor solutions manual available online. A background in elementary calculus is assumed.
Spacetime - Marcus Kriele 2003-07-01
One of the most of exciting aspects is the general relativity pred- tion of black holes and the Such Big Bang. predictions gained weight the theorems through Penrose. singularity pioneered In various by te- books on theorems general relativity singularity are and then presented used to that black holes exist and that the argue universe started with a To date what has big been is bang. a critical of what lacking analysis these theorems predict-’ We of really give a proof a typical singul- theorem and this ity use theorem to illustrate problems arising through the of possibilities violations" and "causality weak "shell very crossing These singularities". add to the problems weight of view that the point theorems alone singularity are not sufficient to the existence of predict physical singularities. The mathematical theme of the book In order to both solid gain a of and intuition understanding good for any mathematical theory, one,should to realise it as model of try a a fam- iar non-mathematical theories have had concept. Physical an especially the important on of and impact development mathematics, conversely various modern theories physical rather require sophisticated mathem- ics for their formulation. both and mathematics Today, physics are so that it is often difficult complex to master the theories in both very s- in the of jects. However, case differential pseudo-Riemannian geometry or the general relativity between and mathematics relationship physics is and it is therefore especially close, to from interd- possible profit an ciplinary approach.
Further Advances in Twistor Theory - L.J. Mason 1995-04-04
Twistor theory is the remarkable mathematical framework that was discovered by Roger Penrose in the course of research into gravitation and quantum theory. It have since developed into a broad, many-faceted programme that attempts to resolve basic problems in physics by encoding the structure of physical fields and indeed space-time itself into the complex analytic geometry of twistor space. Twistor theory has important applications in diverse areas of mathematics and mathematical physics. These include powerful techniques for the solution of nonlinear equations, in particular the self-duality equations both for the Yang-Mills and the Einstein equations, new approaches to the representation theory of Lie groups, and the quasi-local definition of mass in general relativity, to name but a few. This volume and its companions comprise an abundance of new material, including an extensive collection of Twistor Newsletter articles written over a period of 15 years. These trace the development of the twistor programme and its applications over that period and offer an overview on the current status of various aspects of that programme. The articles have been written in an informal and easy-to-read style and have been arranged by the editors into chapter supplemented by detailed introductions, making each volume self-contained and accessible to graduate students

and nonspecialists from other fields. Volume II explores applications of flat twistor space to nonlinear problems. It contains articles on integrable or soluble nonlinear equations, conformal differential geometry, various aspects of general relativity, and the development of Penrose's quasi-local mass construction.

Differential Geometry, Calabi-Yau Theory, and General Relativity (Part 2) - Huai-Dong Cao 2022-06-30

In 2019, mathematicians around the world celebrated the 70th birthday of Professor Shing-Tung Yau and expressed their appreciation and admiration. A number of conferences were held throughout the year for this special occasion: at Harvard University (May), at the University of Rome (May/June), at the Chinese University of Hong Kong (June), at the 8th ICCM Congress at Tsinghua University (June), at Lehigh University (November), and elsewhere. This is the second of the two Surveys in Differential Geometry volumes in honor of Professor Yau, consisting of articles by some of the speakers at those special conferences, and several additional contributions. The articles in this volume include: Tristan C. Collins and Yun Shi, "Stability and the deformed Hermitian Yang-Mills equation"; Simon Donaldson and Christopher Scaduto, "Associative submanifolds and gradient cycles"; Davide Gaiotto and Edward Witten, "Probing quantization via branes"; L. Gottsche and M. Kool, "Sheaves on surfaces and virtual invariants"; Goo Ishikawa and Stanislaw Janeczko, "Symplectic singularities of differentiable mappings"; Jun Li and Chiu-Chu Melissa Liu, "Counting curves in quintic Calabi-Yau threefolds and Landau-Ginzberg models"; Nikolai Nadirashvili et al., "Conformally maximal metrics for Laplace eigenvalues on surfaces"; Kieran G. O'Grady, "Moduli of sheaves on $K3$'s and higher dimensional HK varieties"; Richard Schoen and Shing-Tung Yau "Positive scalar curvature and minimal hypersurface singularities"; Penny Smith and Karen Uhlenbeck, "Removeability of a codimension four singular set for solutions of a Yang-Mills-Higgs equation with small energy"; and Mu-Tao Wang, "Limits of quasi-local angular momentum on an isolated gravitating system".

Izaak Walton's the Compleat Angler - Izaak Walton 1988

Geometric Theory of Generalized Functions with Applications to General Relativity - M. Grosser 2013-04-17

Over the past few years a certain shift of focus within the theory of algebras of generalized functions (in the sense of J. F. Colombeau) has taken place. Originating in infinite dimensional analysis and initially applied mainly to problems in nonlinear partial differential equations involving singularities, the theory has undergone a change both in in ternal structure and scope of applicability, due to a growing number of applications to questions of a more geometric nature. The present book is intended to provide an in-depth presentation of these develop ments comprising its structural aspects within the theory of generalized functions as well as a (selective but, as we hope, representative) set of applications. This main purpose of the book is accompanied by a number of sub ordinate goals which we were aiming at when arranging the material included here. First, despite the fact that by now several excellent mono graphs on Colombeau algebras are available, we have decided to give a self-contained introduction to the field in Chapter 1. Our motivation for this decision derives from two main features of our approach. On the one hand, in contrast to other treatments of the subject we base our intro duction to the field on the so-called special variant of the algebras, which makes many of the fundamental ideas of the field particularly transpar ent and at the same time facilitates and motivates the introduction of the more involved concepts treated later in the chapter.

Mechanics, Analysis and Geometry: 200 Years after Lagrange - M. Francaviglia 2012-12-02

Providing a logically balanced and authoritative account of the different branches and problems of mathematical physics that Lagrange studied and developed, this volume presents up-to-date developments in differential goemetry, dynamical systems, the calculus of variations, and celestial and analytical mechanics.

The Mathematical Principles of Scale Relativity Physics - Nicolae Mazilu 2019-09-24

The Mathematical Principles of Scale Relativity Physics: The Concept of Interpretation explores and builds upon the principles of Laurent Nottale’s scale relativity. The authors address a variety of problems encountered by researchers studying the dynamics of physical systems. It explores Madelung fluid from a wave mechanics point of view, showing that confinement and asymptotic freedom are the fundamental laws of modern natural philosophy. It then probes Nottale’s scale transition description, offering a sound mathematical principle based on continuous group theory. The book provides a comprehensive overview of the matter to the reader via a generalization of relativity, a theory of colors, and classical electrodynamics. Key Features: Develops the concept of scale relativity interpreted according to its initial definition enticed by the birth of wave and quantum mechanics Provides the fundamental equations necessary for interpretation of matter, describing the ensembles of free particles according to the concepts of confinement and asymptotic freedom Establishes a natural connection between the Newtonian forces and the Planck’s law from the point of view of space and time scale transition: both are expressions of invariance to scale transition The work will be of great interest to graduate students, doctoral candidates, and academic researchers working in mathematics and physics.

Manifolds and Differential Geometry - Jeffrey Marc Lee 2009

Differential geometry began as the study of curves and surfaces using the methods of calculus. In time, the notions of curve and surface were generalized along with associated notions such as length, volume, and curvature. At the same time the topic has become closely allied with developments in topology. The basic object is a smooth manifold, to which some extra structure has been attached, such as a Riemannian metric, a symplectic form, a distinguished group of symmetries, or a connection on the tangent bundle. This book is a graduate-level introduction to the tools and structures of modern differential geometry. Included are the topics usually found in a course on differentiable manifolds, such as vector bundles, tensors, differential forms, de Rham cohomology, the Frobenius theorem and basic Lie group theory. The book also contains material on the general theory of connections on vector bundles and an in-depth chapter on semi-Riemannian geometry that covers basic material about Riemannian manifolds and Lorentz manifolds. An unusual feature of the book is the inclusion of an early chapter on the differential geometry of hyper-surfaces in Euclidean space. There is also a section that derives the exterior calculus version of Maxwell's equations. The first chapters of the book are suitable for a one-semester course on manifolds. There is more than enough material for a year-long course on manifolds and geometry.