Geometrical Vectors Chicago Lectures In Physics

This book is a translation of an authoritative introductory text based on a lecture series delivered by the renowned differential geometer, Professor S S Chern in Beijing University in 1980. The original Chinese text, authored by Professor Chern and Professor Wei-Huan Chen, was a unique contribution to the mathematics literature, combining simplicity and economy of approach with depth of contents. The present translation is aimed at a wide audience, including (but not limited to) advanced undergraduate and graduate students in mathematics, as well as physicists interested in the diverse applications of differential geometry to physics. In addition to a thorough treatment of the fundamentals of manifold theory, exterior algebra, the exterior calculus, connections on fiber bundles, Riemannian geometry, Lie groups and moving frames, and complex manifolds (with a succinct introduction to the theory of Chern classes), and an appendix on the relationship between differential geometry and theoretical physics, this book includes a new chapter on Finsler geometry and a new appendix on the history and recent developments of differential geometry, the latter prepared specially for this edition by Professor Chern to bring the text into perspectives.

These notes are based on lectures the author held at the University of Bonn and the Erwin-Schrodinger-Institute in Vienna. The aim is to give a thorough introduction to the theory of Kahler manifolds with special emphasis on the differential geometric side of Kahler geometry. Some familiarity with global analysis and partial differential equations is assumed, in particular in the part on the Calabi conjecture.

From its inception in Greek antiquity, the science of optics was aimed primarily at explaining sight and accounting for why things look as they do. By the end of the seventeenth century, however, the analytic focus of optics had shifted to light: its fundamental properties and such physical behaviors as reflection, refraction, and diffraction. This dramatic shift—which A. Mark Smith characterizes as the “Keplerian turn”—lies at the heart of this fascinating and pioneering study. Breaking from previous scholarship that sees Johannes Kepler as the culmination of a long-evolving optical tradition that traced back to Greek antiquity via the Muslim Middle Ages, Smith presents Kepler instead as marking a rupture with this tradition, arguing that his theory of retinal imaging, which was published in 1604, was instrumental in prompting the turn from sight to light. Kepler’s new theory of sight, Smith reveals, thus takes on true historical significance: by treating the eye as a mere light-focusing device rather than an image-producing instrument—as traditionally understood—Kepler’s account of retinal imaging helped spur the shift in analytic focus that eventually led to modern optics. A sweeping survey, From Sight to Light is poised to become the standard reference for historians of optics as well as those interested more broadly in the history of science, the history of art, and cultural and intellectual history.

This book contains 23 papers of open problems and directions about mapping class groups and related topics. The papers focus on aspects deeply connected with geometric topology, combinatorial group theory and surrounding areas.

Monographs on Statistics and Applied Probability

Mathematical Methods Of Theoretical Physics

Electrodynamics

An American National Bibliography

Confessions of a Jewish Priest

American Journal of Physics

This book contains very explicit proofs and demonstrations through examples for a comprehensive introduction to the mathematical methods of theoretical physics. It also combines and unifies many expositions of this subject, suitable for readers with interest in experimental and applied physics.

Gravity’s Ghost and Big Dog brings to life science’s efforts to detect cosmic gravitational waves. These ripples in space-time are predicted by general relativity, and their discovery will not only demonstrate the truth of Einstein’s theories but also transform astronomy. Although no gravitational wave has ever been directly detected, the previous five years have been an especially exciting period in the field. Here sociologist Harry Collins offers readers an unprecedented view of gravitational wave research and explains what it means for an analyst to do work of this kind. Collins was embedded with the gravitational wave physicists as they confronted two possible discoveries—“Big Dog,” fully analyzed in this volume for the first time, and the “Equinox Event,” which was first chronicled by Collins in Gravity’s Ghost. Collins records the agonizing arguments that arose as the scientists worked out what they had seen and how to present it to the world, along the way demonstrating how even the most statistical of sciences rest on social and philosophical choices. Gravity’s Ghost and Big Dog draws on nearly fifty years of fieldwork observing scientists at the American Laser Interferometer Gravitational Wave Observatory and elsewhere around the world to offer an inspired commentary on the place of science in society today.

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.

This unique book provides a streamlined, self-contained and modern text for a one-semester mathematical methods course with an emphasis on concepts important from the application point of view. Part I of this book follows the ?paper and pencil? presentation of mathematical methods that emphasizes fundamental understanding and geometrical intuition. In addition to a complete list of standard subjects, it introduces important, contemporary topics like nonlinear differential equations, chaos and solitons. Part II employs the Maple software to cover the same topics as in Part I in a computer oriented approach to instruction. Using Maple liberates students from laborious tasks while helping them to concentrate entirely on concepts and on better visualizing the mathematical content. The focus of the text is on key ideas and basic technical and geometric insights presented in a way that closely reflects how physicists and engineers actually think about mathematics.

Trends in Electromagnetism

Global Differential Geometry

Mathematical Reviews

Core Principles of Special and General Relativity

Spacetime and Geometry

Scientific Discovery and Social Analysis in the Twenty-First Century

Spacetime and Geometry is an introductory textbook on general relativity, specifically aimed at students. Using a lucid style, Carroll first covers the foundations of the theory and mathematical formalism, providing an approachable introduction to what can often be an intimidating subject. Three major applications of general relativity are then discussed: black holes, perturbation theory and gravitational waves, and cosmology. Students will learn the origin of how spacetime curves (the Einstein equation) and how matter moves through it (the geodesic equation). They will learn what black holes really are, how gravitational waves are generated and detected, and the modern view of the expansion of the universe. A brief introduction to quantum field theory in curved spacetime is also included. A student familiar with this book will be ready to tackle research-level problems in gravitational physics.

The Confessions of a Jewish Priest are the reminiscences of Gabriel Weinreich, a secular Jew who was born in Poland and moved to the U.S. as a young adolescent during World War II thus narrowly escaping the Holocaust. The book follows Weinreich as he becomes an American, twice-husband, father, and an award-winning scientist, and shows how his subsequent journey toward Christianity and ordination to the Episcopal priesthood do nothing to impair his sense of "Jewishness."In addition to telling a compelling life story of a boy from an eminent Jewish family, the book takes us on a journey into Christianity as perceived by a Jew who began as a complete atheist--but realizes later in life that he never really was an atheist after all.

A straightforward introduction to Clifford algebras, providing the necessary background material and many applications in mathematics and physics.

This book revisits the mathematical foundations of thermodynamics and gauge theory by using new differential geometric methods coming from the formal theory of systems of partial differential equations and Lie pseudogroups. The gauge theory of gravity is also established, in which spinorial and ventorial matter fields serve as gravitating sources. The potential applications of the present gauge theory of gravity, including quantum-vacuum-energy gravity, cosmological constant problem and gravity-gauge unification is also addressed. The third chapter focuses on a gravitational gauge theory with spin connection and vierbein as fundamental variables of gravity. Next, the place and physical significance of Poincaré gauge theory of gravity (PGTG) in the framework of gauge approach to gravitation is discussed. A cutoff regularization method in gauge theory is discussed in Chapter Five. The remaining chapters in the book focus on differential geometry, in particular, the authors show how fractional differential derived from fractional difference provides a basis to expand a theory of fractional differential geometry which would apply to non-differentiable manifolds; a review of the infinitesimal Baker-Campbell-Hausdorff formula is provided and the book concludes with a short communication where the authors focus on local stability, and describe how this leads naturally into the question of finite-time singularities and generalized soliton solutions.

The Evanston Colloquium

American Book Publishing Record

Lectures on Kähler Manifolds

From Secular Jewish War Refugee to Physicist and Episcopal Clergyman

Kaon Physics

Gauge Theories and Differential Geometry

Practically all of modern physics deals with fields—functions of space (or spacetime) that give the value of a certain quantity, such as the temperature, in terms of its location within a prescribed volume. Electrodynamics is a comprehensive study of the field produced by (and interacting with) charged particles, which in practice means almost all matter. Fulvio Melia's Electrodynamics offers a concise, compact, yet complete treatment of this important branch of physics. Unlike most of the standard texts, Electrodynamics neither assumes familiarity with basic concepts nor ends before reaching advanced theoretical principles. Instead this book takes a continuous approach, leading the reader from fundamental physical principles through to a relativistic Lagrangian formalism that overlaps with the field theoretic techniques used in other branches of advanced physics. Avoiding unnecessary technical details and calculations, Electrodynamics will serve both as a useful supplemental text for graduate and advanced undergraduate students and as a helpful overview for physicists who specialize in other fields.

Perspectives in Computation covers three broad topics: the computation process & its limitations; the search for computational efficiency; & the role of quantum mechanics in computation.

Building from his lecture notes, Eaton (mathematics, U. of Minnesota) has designed this text to support either a one-year class in graduate-level multivariate courses or independent study. He presents a version of multivariate statistical theory in which vector space and invariance methods replace to a large extent more traditional multivariate methods. Using extensive examples and exercises Eaton describes vector space theory, random vectors, the normal distribution on a vector space, linear statistical models, matrix factorization and Jacobians, topological groups and invariant measures, first applications of invariance, the Wishart distribution, inferences for means in multivariate linear models and canonical correlation coefficients. Eaton also provides comments on selected exercises and a bibliography.

A concise and up-to-date introduction to mathematical methods for students in the physical sciences Mathematical Methods in Physics, Engineering and Chemistry offers an introduction to the most important methods of theoretical physics. Written by two physics professors with years of experience, the text puts the focus on the essential math topics that the majority of physical science students require in the course of their studies. This concise text also contains worked examples that clearly illustrate the mathematical concepts presented and shows how they apply to physical problems. This targeted text covers a range of topics including linear algebra, partial differential equations, power series, Sturm-Liouville theory, Fourier series, special functions, complex analysis, the Green’s function method, integral equations, and tensor analysis. This important text: Provides a streamlined approach to the subject by putting the focus on the mathematical topics that physical science students really need Offers a text that is different from the often-found definition-theorem-proof scheme Includes more than 150 worked examples that help with an understanding of the problems presented Presents a guide with more than 200 exercises with different degrees of difficulty Written for advanced undergraduate and graduate students of physics, materials science, and engineering, Mathematical Methods in Physics, Engineering and Chemistry includes the essential methods of theoretical physics. The text is streamlined to provide only the most important mathematical concepts that apply to physical problems.

Characteristic Classes

Foundations of Data Science

Tensor Methods in Statistics

Multivariate Statistics

Perspectives in Computation

A Short Course in Mathematical Methods with Maple

The theory of characteristic classes provides a meeting ground for the various disciplines of differential topology, differential and algebraic geometry, cohomology, and fiber bundle theory. As such, it is a fundamental and an essential tool in the study of differentiable manifolds. In this volume, the authors provid introduction to characteristic classes, with detailed studies of Stiefel-Whitney classes, Chern classes, Pontrjagin classes, and the Euler class. Three appendices cover the basics of cohomology theory and the differential forms approach to characteristic classes, and provide an account of Bernoulli numbers. Ba of John Milnor, which first appeared at Princeton University in 1957 and have been widely studied by graduate students of topology ever since, this published version has been completely revised and corrected.

This book presents the foundations of the theory of groups and semigroups acting isometrically on Gromov hyperbolic metric spaces. Particular emphasis is paid to the geometry of their limit sets and on behavior not found in the proper setting. The authors provide a number of examples of groups which exhibi phenomena not to be found in the finite-dimensional theory. The book contains both introductory material to help beginners as well as new research results, and closes with a list of attractive unsolved problems.

The academic year 1996-97 was designated as a special year in Algebraic Topology at Northwestern University (Evanston, IL). In addition to guest lecturers and special courses, an international conference was held entitled ""Current trends in algebraic topology with applications to algebraic geometry and phy of plenary lectures included in this volume indicate the great breadth of the conference and the lively interaction that took place among various areas of mathematics. Original research papers were submitted, and all submissions were refereed to the usual journal standards. It features a paper prepared by C. F Miller theorem, and a set of problems presented at a special problem session held at the conference.

In 1947, the first of what have come to be known as "strange particles" were detected. As the number and variety of these particles proliferated, physicists began to try to make sense of them. Some seemed to have masses about 900 times that of the electron, and existed in both charged and neutral varieties. called kaons (or K mesons), and they have become the subject of some of the most exciting research in particle physics. Kaon Physics at the Turn of the Millennium presents cutting-edge papers by leading theorists and experimentalists that synthesize the current state of the field and suggest promising new d study of kaons. Topics covered include the history of kaon physics, direct CP violation in kaon decays, time reversal violation, CPT studies, theoretical aspects of kaon physics, rare kaon decays, hyperon physics, charm: CP violation and mixing, the physics of B mesons, and future opportunities for kaon physi century.

Riemannian Manifolds

Mathematical Physics

Tensor Calculus for Engineers and Physicists

The Mathematical Legacy of Alfred Gray : International Congress on Differential Geometry September 18-23, 2000, Bilbao, Spain

A Vector Space Approach

Topics in the Foundations of General Relativity and Newtonian Gravitation Theory

Mathematical Physics is an introduction to such basic mathematical structures as groups, vector spaces, topological spaces, measure spaces, and Hilbert space. Geroch uses category theory to emphasize both the interrelationships among different structures and the unity of mathematics. Perhaps the most valuable feature of the book is the illuminating intuitive discussion of the "whys" of proofs and of axioms and definitions. This book, based on Geroch's University of Chicago course, will be especially helpful to those working in theoretical physics, including such areas as relativity, particle physics, and astrophysics.

This book provides a systematic development of tensor methods in statistics, beginning with the study of multivariate moments and cumulants. The effect on moment arrays and on cumulant arrays of making linear or affine transformations of the variables is studied. Because of their importance in statistical theory, invariant functions of the cumulants are studied in some detail. This is followed by an examination of the effect of making a polynomial transformation of the original variables. The fundamental operation of summing over complementary set partitions is introduced at this stage. This operation shapes the notation and pervades much of the remainder of the book. The necessary lattice-theory is discussed and suitable tables of complementary set partitions are provided. Subsequent chapters deal with asymptotic approximations based on Edgeworth expansion and saddlepoint expansion. The saddlepoint expansion is introduced via the Legendre transformation of the cumulant generating function, also known as the conjugate function of the cumulant generating function. A recurring them is that, with suitably chosen notation, multivariate calculations are often simpler and more transparent than the corresponding univariate calculations. The final two chapters deal with likelihood ratio statistics, maximum likelihood estimation and the effect on inferences of conditioning on ancillary or approximately ancillary statistics. The Bartlett adjustment factor is derived in the general case and simplified for certain types of generalized linear models. Finally, Barndorff-Nielsen's formula for the conditional distribution of the maximum liklelihood estimator is derived and discussed. More than 200 Exercises are provided to illustrate the uses of tensor methodology.

Covers mathematical and algorithmic foundations of data science: machine learning, high-dimensional geometry, and analysis of large networks.

The Geometry and Topology of Coxeter Groups is a comprehensive and authoritative treatment of Coxeter groups from the viewpoint of geometric group theory. Groups generated by reflections are ubiquitous in mathematics, and there are classical examples of reflection groups in spherical, Euclidean, and hyperbolic geometry. Any Coxeter group can be realized as a group generated by reflection on a certain contractible cell complex, and this complex is the principal subject of this book. The book explains a theorem of Moussong that demonstrates that a polyhedral metric on this cell complex is nonpositively curved, meaning that Coxeter groups are "CAT(0) groups." The book describes the reflection group trick, one of the most potent sources of examples of aspherical manifolds. And the book discusses many important topics in geometric group theory and topology, including Hopf's theory of ends; contractible manifolds and homology spheres; the Poincaré Conjecture; and Gromov's theory of CAT(0) spaces and groups. Finally, the book examines connections between Coxeter groups and some of topology's most famous open problems concerning aspherical manifolds, such as the Euler Characteristic Conjecture and the Borel and Singer conjectures.

An Introduction to Curvature

Pythagorean-Hodograph Curves: Algebra and Geometry Inseparable

Geometry and Dynamics in Gromov Hyperbolic Metric Spaces

From Fundamentals to Applications

Lectures on Differential Geometry

This text focuses on developing an intimate acquaintance with the geometric meaning of curvature and thereby introduces and demonstrates all the main technical tools needed for a more advanced course on Riemannian manifolds. It covers proving the four most fundamental theorems relating curvature and topology: the Gauss-Bonnet Theorem, the Cartan-Hadamard Theorem, Bonnet’s Theorem, and a special case of the Cartan-Ambrose-Hicks Theorem.

Designed as a self-contained account of a number of key algorithmic problems and their solutions for linear algebraic groups, this book combines in one single text both an introduction to the basic theory of linear algebraic groups and a substantial collection of useful algorithms. Computation with Linear Algebraic Groups offers an invaluable guide to graduate students and researchers working in algebraic groups, computational algebraic geometry, and computational group theory, as well as those looking for a concise introduction to the theory of linear algebraic groups.

Engineers must make decisions regarding the distribution of expensive resources in a manner that will be economically beneficial. This problem can be realistically formulated and logically analyzed with optimization theory. This book shows engineers how to use optimization theory to solve complex problems. Unifies the large field of optimization with a few geometric principles. Covers functional analysis with a minimum of mathematics. Contains problems that relate to the applications in the book.

In Topics in the Foundations of General Relativity and Newtonian Gravitation Theory, David B. Malament presents the basic logical-mathematical structure of general relativity and considers a number of special topics concerning the foundations of general relativity and its relation to Newtonian gravitation theory. These special topics include the geometrized formulation of Newtonian theory (also known as Newton-Cartan theory), the concept of rotation in general relativity, and Gödel spacetime. One of the highlights of the book is a no-go theorem that can be understood to show that there is no criterion of orbital rotation in general relativity that fully answers to our classical intuitions. Topics is intended for both students and researchers in mathematical physics and philosophy of science.

From Sight to Light

Computation with Linear Algebraic Groups

Proceedings of a Conference on Homotopy Theory, March 23-27, 1997, Northwestern University

Lectures on Mathematics Delivered from Aug. 28 to Sept. 9, 1893 Before Members of the Congress of Mathematics Held in Connection with the World's Fair in Chicago at Northwestern University, Evanston, Ill

The Geometry and Topology of Coxeter Groups. (LMS-32)
Homotopy Theory Via Algebraic Geometry and Group Representations

This textbook provides a rigorous approach to tensor manifolds in several aspects relevant for Engineers and Physicists working in industry or academia. With a thorough, comprehensive, and unified presentation, this book offers insights into several topics of tensor analysis, which covers all aspects of n-dimensional spaces. The main purpose of this book is to give a self-contained yet simple, correct and comprehensive mathematical explanation of tensor calculus for undergraduate and graduate students and for professionals. In addition to many worked problems, this book features a selection of examples, solved step by step. Although no emphasis is placed on special and particular problems of Engineering or Physics, the text covers the fundamentals of these fields of science. The book makes a brief introduction into the basic concept of the tensorial formalism so as to allow the reader to make a quick and easy review of the essential topics that enable having the grounds for the subsequent themes, without needing to resort to other bibliographical sources on tensors. Chapter 1 deals with Fundamental Concepts about tensors and chapter 2 is devoted to the study of covariant, absolute and contravariant derivatives. The chapters 3 and 4 are dedicated to the Integral Theorems and Differential Operators, respectively. Chapter 5 deals with Riemann Spaces, and finally the chapter 6 presents a concise study of the Parallelism of Vectors. It also shows how to solve various problems of several particular manifolds.

This book provides a comprehensive introduction to modern global variational theory on fibred spaces. It is based on differentiation and integration theory of differential forms on smooth manifolds, and on the concepts of global analysis and geometry such as jet prolongations of manifolds, mappings, and Lie groups. The book will be invaluable for researchers and PhD students in differential geometry, global analysis, differential equations on manifolds, and mathematical physics, and for the readers who wish to undertake further rigorous study in this broad interdisciplinary field. Featured topics - Analysis on manifolds - Differential forms on jet spaces - Global variational functionals - Euler-Lagrange mapping - Helmholtz form and the inverse problem - Symmetries and the Noether's theory of conservation laws - Regularity and the Hamilton theory - Variational sequences - Differential invariants and natural variational principles - First book on the geometric foundations of Lagrange structures - New ideas on global variational functionals - Complete proofs of all theorems - Exact treatment of variational principles in field theory, inc. general relativity - Basic structures and tools: global analysis, smooth manifolds, fibred spaces

This book provides an accessible, yet thorough, introduction to special and general relativity, crafted and class-tested over many years of teaching. Suitable for advanced undergraduate and graduate students, this book provides clear descriptions of how to approach the mathematics and physics involved. It is also contains the latest exciting developments in the field, including dark energy, gravitational waves, and frame dragging. The table of contents has been carefully developed in consultation with a large number of instructors teaching courses worldwide, to ensure its wide applicability to modules on relativity and gravitation. Features: A clear, accessible writing style, presenting a sophisticated approach to the subject, that remains suitable for advanced undergraduate students and above Class-tested over many years To be accompanied by a partner volume on 'Advanced Topics' for students to further extend their learning

By virtue of their special algebraic structures, Pythagorean-hodograph (PH) curves offer unique advantages for computer-aided design and manufacturing, robotics, motion control, path planning, computer graphics, animation, and related fields. This book offers a comprehensive and self-contained treatment of the mathematical theory of PH curves, including algorithms for their construction and examples of their practical applications. It emphasizes the interplay of ideas from algebra and geometry and their historical origins and includes many figures, worked examples, and detailed algorithm descriptions.

Introduction to Global Variational Geometry
Problems on Mapping Class Groups and Related Topics
Clifford Algebras: An Introduction
The Passage from Ancient to Modern Optics
Optimization by Vector Space Methods
Mathematical Methods in Physics, Engineering, and Chemistry

Among the branches of classical physics, electromagnetism is the domain which experiences the most spectacular development, both in its fundamental and practical aspects. The quantum corrections which generate non-linear terms of the standard Maxwell equations, their specific form in curved spaces, whose predictions can be confronted with the cosmic polarization rotation, or the topological model of electromagnetism, constructed with electromagnetic knots, are significant examples of recent theoretical developments. The similarities of the Sturm-Liouville problems in electromagnetism and quantum mechanics make possible deep analogies between the wave propagation in waveguides, ballistic electron movement in mesoscopic conductors and light propagation on optical fibers, facilitating a better understanding of these topics and fostering the transfer of techniques and results from one domain to another. Industrial applications, like magnetic refrigeration at room temperature or use of metamaterials for antenna couplers and covers, are of utmost practical interest. So, this book offers an interesting and useful reading for a broad category of specialists.

Every advanced undergraduate and graduate student of physics must master the concepts of vectors and vector analysis. Yet most books cover this topic by merely repeating the introductory-level treatment based on a limited algebraic or analytic view of the subject. Geometrical Vectors introduces a more sophisticated approach, which not only brings together many loose ends of the traditional treatment, but also leads directly into the practical use of vectors in general curvilinear coordinates by carefully separating those relationships which are topologically invariant from those which are not. Based on the essentially geometric nature of the subject, this approach builds consistently on students' prior knowledge and geometrical intuition. Written in an informal and personal style, Geometrical Vectors provides a handy guide for any student of vector analysis. Clear, carefully constructed line drawings illustrate key points in the text, and problem sets as well as physical examples are provided.

American Book Publishing Record Cumulative, 1950-1977
Geometrical Vectors
Gravity's Ghost and Big Dog