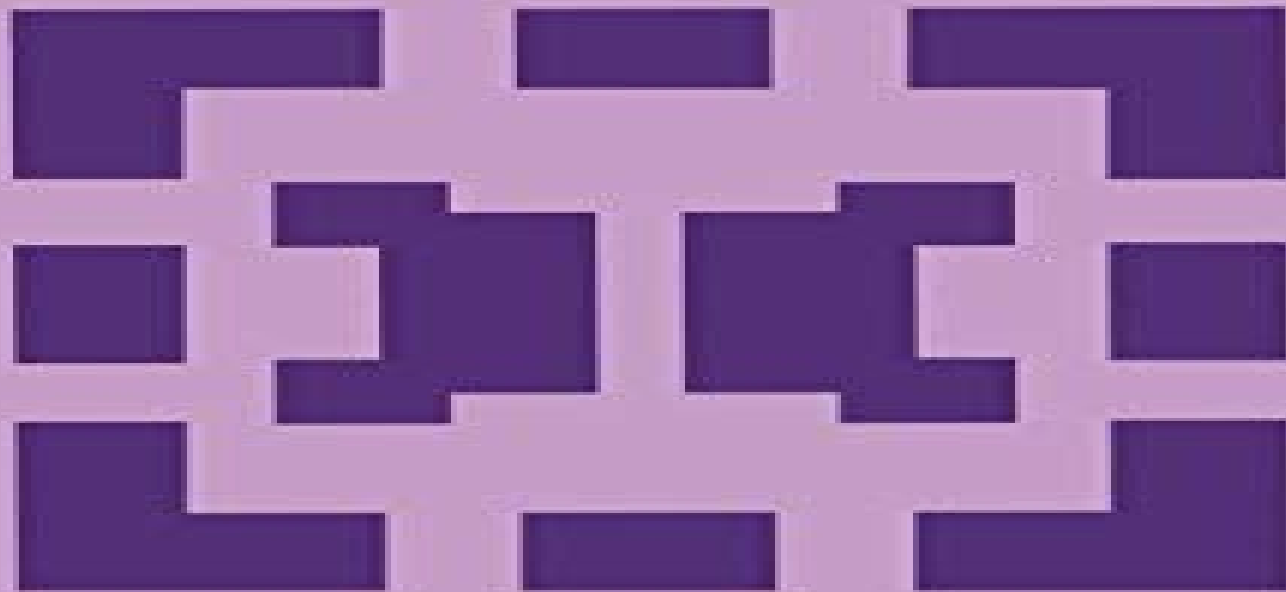


Mathematics and Its Applications

Demir N. Kupeli

**Singular Semi-Riemannian
Geometry**



Kluwer Academic Publishers

Singular Semi Riemannian Geometry

Anastasios Mallios



Singular Semi Riemannian Geometry:

Singular Semi-Riemannian Geometry D.N. Kupeli, 2013-03-09 This book is an exposition of Singular Semi Riemannian Geometry the study of a smooth manifold furnished with a degenerate singular metric tensor of arbitrary signature The main topic of interest is those cases where the metric tensor is assumed to be nondegenerate In the literature manifolds with degenerate metric tensors have been studied extrinsically as degenerate submanifolds of semi Riemannian manifolds One major aspect of this book is first to study the intrinsic structure of a manifold with a degenerate metric tensor and then to study it extrinsically by considering it as a degenerate submanifold of a semi Riemannian manifold This book is divided into three parts Part I deals with singular semi Riemannian manifolds in four chapters In Chapter I the linear algebra of indefinite real inner product spaces is reviewed In general properties of certain geometric tensor fields are obtained purely from the algebraic point of view without referring to their geometric origin Chapter II is devoted to a review of covariant derivative operators in real vector bundles Chapter III is the main part of this book where intrinsically the Koszul connection is introduced and its curvature identities are obtained In Chapter IV an application of Chapter III is made to degenerate submanifolds of semi Riemannian manifolds and Gauss Codazzi and Ricci equations are obtained Part II deals with singular Kahler manifolds in four chapters parallel to Part I

Mat-report, 1990 **Singular Semi Riemannian Geometry** Jens Chr Larsen, Danmarks Tekniske Højskole. Matematisk Institut, 1990 *Osserman Manifolds in Semi-Riemannian Geometry* Eduardo Garcia-Rio, Demir N. Kupeli, Ramon Vazquez-Lorenzo, 2004-10-12 The subject of this book is Osserman semi Riemannian manifolds and in particular the Osserman conjecture in semi Riemannian geometry The treatment is pitched at the intermediate graduate level and requires some intermediate knowledge of differential geometry The notation is mostly coordinate free and the terminology is that of modern differential geometry Known results toward the complete proof of Riemannian Osserman conjecture are given and the Osserman conjecture in Lorentzian geometry is proved completely Counterexamples to the Osserman conjecture in generic semi Riemannian signature are provided and properties of semi Riemannian Osserman manifolds are investigated

[Null Curves and Hypersurfaces of Semi-Riemannian Manifolds](#) Krishan L. Duggal, Dae Ho Jin, 2007 This is a first textbook that is entirely focused on the up to date developments of null curves with their applications to science and engineering It fills an important gap in a second level course in differential geometry as well as being essential for a core undergraduate course on Riemannian curves and surfaces The sequence of chapters is arranged to provide in depth understanding of a chapter and stimulate further interest in the next The book comprises a large variety of solved examples and rigorous exercises that range from elementary to higher levels This unique volume is self contained and unified in presenting A systematic account of all possible null curves their Frenet equations unique null Cartan curves in Lorentzian manifolds and their practical problems in science and engineering The geometric and physical significance of null geodesics mechanical systems involving curvature of null curves simple variation problems and the interrelation of null

curves with hypersurfaces Semi-Riemannian Maps and Their Applications Eduardo García-Río,D.N. Kupeli,2013-06-29 A major flaw in semi Riemannian geometry is a shortage of suitable types of maps between semi Riemannian manifolds that will compare their geometric properties Here a class of such maps called semi Riemannian maps is introduced The main purpose of this book is to present results in semi Riemannian geometry obtained by the existence of such a map between semi Riemannian manifolds as well as to encourage the reader to explore these maps The first three chapters are devoted to the development of fundamental concepts and formulas in semi Riemannian geometry which are used throughout the work In Chapters 4 and 5 semi Riemannian maps and such maps with respect to a semi Riemannian foliation are studied Chapter 6 studies the maps from a semi Riemannian manifold to 1 dimensional semi Euclidean space In Chapter 7 some splitting theorems are obtained by using the existence of a semi Riemannian map Audience This volume will be of interest to mathematicians and physicists whose work involves differential geometry global analysis or relativity and gravitation

Progress in Lorentzian Geometry Waldemar Barrera,Jónatan Herrera,Juan Pablo Navarrete,Matias Navarro,Oscar Palmas,Didier A. Solis,2025-09-30 This proceedings volume gathers selected revised papers presented at the XI International Meeting on Lorentzian Geometry GeLoMer 2024 held at the Autonomous University of Yucatán Mexico from January 29 to February 2 2024 Lorentzian geometry provides the mathematical foundation for Einstein's theory of relativity It incorporates aspects from different branches of mathematics such as differential geometry partial differential equations and mathematical analysis to name a few This volume includes surveys describing the state of the art in specific areas and a selection of the most relevant results presented at the conference which is seen as a benchmark for those working in Lorentz geometry due to its relevance Given its scope the book will be of interest to both young and experienced mathematicians and physicists whose research involves general relativity and semi Riemannian geometry **Symmetries of Spacetimes and**

Riemannian Manifolds Krishan L. Duggal,Ramesh Sharma,2013-11-22 This book provides an upto date information on metric connection and curvature symmetries used in geometry and physics More specifically we present the characterizations and classifications of Riemannian and Lorentzian manifolds in particular the spacetimes of general relativity admitting metric i.e Killing holothetic and conformal connection i.e affine conformal and projective and curvature symmetries Our approach in this book has the following outstanding features a It is the first ever attempt of a comprehensive collection of the works of a very large number of researchers on all the above mentioned symmetries b We have aimed at bringing together the researchers interested in differential geometry and the mathematical physics of general relativity by giving an invariant as well as the index form of the main formulas and results c Attempt has been made to support several main mathematical results by citing physical examples as applied to general relativity d Overall the presentation is self contained fairly accessible and in some special cases supported by an extensive list of cited references e The material covered should stimulate future research on symmetries Chapters 1 and 2 contain most of the prerequisites for reading the

rest of the book We present the language of semi Euclidean spaces manifolds their tensor calculus geometry of null curves non degenerate and degenerate light like hypersurfaces All this is described in invariant as well as the index form

Lightlike Submanifolds of Semi-Riemannian Manifolds and Applications Krishan L. Duggal,Aurel

Bejancu,2013-04-17 This book is about the light like degenerate geometry of submanifolds needed to fill a gap in the general theory of submanifolds The growing importance of light like hypersurfaces in mathematical physics in particular their extensive use in relativity and very limited information available on the general theory of lightlike submanifolds motivated the present authors in 1990 to do collaborative research on the subject matter of this book Based on a series of author s papers Bejancu 3 Bejancu Duggal 1 3 Dug gal 13 Duggal Bejancu 1 2 3 and several other researchers this volume was conceived and developed during the Fall 91 and Fall 94 visits of Bejancu to the University of Windsor Canada The primary difference between the lightlike submanifold and that of its non degenerate counterpart arises due to the fact that in the first case the normal vector bundle intersects with the tangent bundle of the submanifold Thus one fails to use in the usual way the theory of non degenerate submanifolds cf Chen 1 to define the induced geometric objects such as linear connection second fundamental form Gauss and Weingarten equations on the light like submanifold Some work is known on null hypersurfaces and degenerate submanifolds see an up to date list of references on pages 138 and 140 respectively Our approach in this book has the following outstanding features a It is the first ever attempt of an up to date information on null curves lightlike hypersur faces and submanifolds consistent with the theory of non degenerate submanifolds

Geometry of Vector Sheaves Anastasios Mallios,2012-12-06 This two volume monograph obtains fundamental notions and results of the standard differential geometry of smooth C ∞ manifolds without using differential calculus Here the sheaf theoretic character is emphasised This has theoretical advantages such as greater perspective clarity and unification but also practical benefits ranging from elementary particle physics via gauge theories and theoretical cosmology differential spaces to non linear PDEs generalised functions Thus more general applications which are no longer smooth in the classical sense can be coped with The treatise might also be construed as a new systematic endeavour to confront the ever increasing notion that the world around us is far from being smooth enough Audience This work is intended for postgraduate students and researchers whose work involves differential geometry global analysis analysis on manifolds algebraic topology sheaf theory cohomology functional analysis or abstract harmonic analysis

Differential Geometry of Varieties with Degenerate Gauss Maps Maks A. Aivis,Vladislav V. Goldberg,2006-04-18 In this book the authors study the differential geometry of varieties with degenerate Gauss maps They use the main methods of differential geometry namely the methods of moving frames and exterior differential forms as well as tensor methods By means of these methods the authors discover the structure of varieties with degenerate Gauss maps determine the singular points and singular varieties find focal images and construct a classification of the varieties with degenerate Gauss maps The authors introduce the above mentioned methods and apply

them to a series of concrete problems arising in the theory of varieties with degenerate Gauss maps What makes this book unique is the authors use of a systematic application of methods of projective differential geometry along with methods of the classical algebraic geometry for studying varieties with degenerate Gauss maps This book is intended for researchers and graduate students interested in projective differential geometry and algebraic geometry and their applications It can be used as a text for advanced undergraduate and graduate students Each author has published over 100 papers and they have each written a number of books including Conformal Differential Geometry and Its Generalizations Wiley 1996 Projective Differential Geometry of Submanifolds North Holland 1993 and Introductory Linear Algebra Prentice Hall 1972 which were written by them jointly

Geometry of Lie Groups B. Rosenfeld, Bill Wiebe, 2013-03-09 This book is the result of many years of research in Non Euclidean Geometries and Geometry of Lie groups as well as teaching at Moscow State University 1947 1949 Azerbaijan State University Baku 1950 1955 Kolomna Pedagogical College 1955 1970 Moscow Pedagogical University 1971 1990 and Pennsylvania State University 1990 1995 My first books on Non Euclidean Geometries and Geometry of Lie groups were written in Russian and published in Moscow Non Euclidean Geometries 1955 Ro1 Multidimensional Spaces 1966 Ro2 and Non Euclidean Spaces 1969 Ro3 In Ro1 I considered non Euclidean geometries in the broad sense as geometry of simple Lie groups since classical non Euclidean geometries hyperbolic and elliptic are geometries of simple Lie groups of classes B_n and D and geometries of complex n and quaternionic Hermitian elliptic and hyperbolic spaces are geometries of simple Lie groups of classes A_n and e_n Ro1 contains an exposition of the geometry of classical real non Euclidean spaces and their interpretations as hyperspheres with identified antipodal points in Euclidean or pseudo Euclidean spaces and in projective and conformal spaces Numerous interpretations of various spaces different from our usual space allow us like stereoscopic vision to see many traits of these spaces absent in the usual space

Topological Fixed Point Theory of Multivalued Mappings Lech Górniewicz, 2013-11-11 This book is an attempt to give a systematic presentation of results and methods which concern the fixed point theory of multivalued mappings and some of its applications In selecting the material we have restricted ourselves to studying topological methods in the fixed point theory of multivalued mappings and applications mainly to differential inclusions Thus in Chapter III the approximation on the graph method in fixed point theory of multivalued mappings is presented Chapter IV is devoted to the homological methods and contains more general results e.g. the Lefschetz Fixed Point Theorem the fixed point index and the topological degree theory In Chapter V applications to some special problems in fixed point theory are formulated Then in the last chapter a direct applications to differential inclusions are presented Note that Chapter I and Chapter II have an auxiliary character and only results connected with the Banach Contraction Principle see Chapter II are strictly related to topological methods in the fixed point theory In the last section of our book see Section 75 we give a bibliographical guide and also signal some further results which are not contained in our monograph The author thanks several colleagues and my wife Maria who read and

commented on the manuscript These include J Andres A Buraczewski G Gabor A Gorka M Gorniewicz S Park and A Wieczorek The author wish to express his gratitude to P Konstanty for preparing the electronic version of this monograph

New Developments in Differential Geometry, Budapest 1996 J. Szenthe, 2012-12-06 Proceedings of the Conference on Differential Geometry Budapest Hungary July 27 30 1996 2nd Karl Schwarzschild Meeting on Gravitational Physics

Piero Nicolini, Matthias Kaminski, Jonas Mureika, Marcus Bleicher, 2018-09-22 This book presents the proceedings of the 2nd Karl Schwarzschild Meeting on Gravitational Physics focused on the general theme of black holes gravity and information Specialists in the field of black hole physics and rising young researchers present the latest findings on the broad topic of black holes gravity and information highlighting its applications to astrophysics cosmology particle physics and strongly correlated systems **Differential Geometry of Lightlike Submanifolds** Krishan L. Duggal, Bayram Sahin, 2011-02-02

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

Global Lorentzian Geometry John K. Beem, 2017-09-29 Bridging the gap between modern differential geometry and the mathematical physics of general relativity this text in its second edition includes new and expanded material on topics such as the instability of both geodesic completeness and geodesic incompleteness for general space times geodesic connectivity the generic condition the sectional curvature function in a neighbourhood of degenerate two plane and proof of the Lorentzian Splitting Theorem Five or more copies may be ordered by college or university stores at a special student price available on request

Simulated Evolution and Learning Kalyanmoy Deb, Arnab Bhattacharya, Nirupam Chakraborti, Partha Chakraborty, Swagatam Das, Joydeep Dutta, Santosh K. Gupta, Ashu Jain, Varun Aggarwal, Juergen Branke, Sushil J. Louis, Kay Chen Tan, 2010-11-22 6 eptancerateandshortpapersaddanother13 Differentiable and Complex Dynamics of Several Variables Pei-Chu Hu, Chung-Chun Yang, 2013-04-17 The development of dynamics theory began with the work of Isaac Newton In his theory the most basic law of classical mechanics is $f = ma$ which describes the motion n in \mathbb{R}^n of a point of mass m under the action of a force f by giving the acceleration a If n the position of the point is taken to be a point $x \in \mathbb{R}^n$ and if the force f is supposed to be a function of x only Newton's Law is a description in terms of a second order ordinary differential equation $J^2x = m \frac{d^2x}{dt^2} = f(x)$ It makes sense to reduce the equations to first order by defining the velocity as an extra n independent variable by $v \in \mathbb{R}^n$ Then $x, v \in \mathbb{R}^{2n}$ Euler J L Lagrange and others studied mechanics by means of an analytical method called analytical dynamics Whenever the force f is represented by a gradient vector field $f = -\nabla U$ of the potential energy U and denotes the difference of the kinetic energy and the potential energy by $1/2 \|x\|^2 - U(x)$ the Newton equation of motion is reduced to the Euler Lagrange equation are used as the variables the Euler Lagrange equation can be If the momenta y written as $y = \frac{\partial L}{\partial v}$ Further $W = R - \frac{1}{2} \|x\|^2 + U(x)$ *Dynamics of One-Dimensional Maps* A.N. Sharkovsky, S.F. Kolyada, A.G. Sivak, V.V. Fedorenko, 1997-04-30 maps whose topological entropy is equal to zero i.e. maps that have only

cycles of period 2 are studied in detail and classified. Various topological aspects of the dynamics of unimodal maps are studied in Chapter 5. We analyze the distinctive features of the limiting behavior of trajectories of smooth maps. In particular, for some classes of smooth maps we establish theorems on the number of sinks and study the problem of existence of wandering intervals. In Chapter 6, for a broad class of maps we prove that almost all points with respect to the Lebesgue measure are attracted by the same sink. Our attention is mainly focused on the problem of existence of an invariant measure absolutely continuous with respect to the Lebesgue measure. We also study the problem of Lyapunov stability of dynamical systems and determine the measures of repelling and attracting invariant sets. The problem of stability of separate trajectories under perturbations of maps and the problem of structural stability of dynamical systems as a whole are discussed in Chapter 7. In Chapter 8 we study one-parameter families of maps. We analyze bifurcations of periodic trajectories and properties of the set of bifurcation values of the parameter including universal properties such as Feigenbaum universality.

Whispering the Secrets of Language: An Psychological Quest through **Singular Semi Riemannian Geometry**

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