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Singularities of Differentiable Maps, Volume 1

Classification of Critical Points,
Caustics and Wave Fronts

Singularities Of Differentiable Maps The Classification Of Critical Points Caustics And Wave Fronts Vol 1

**V.I. Arnold, A.N. Varchenko, S.M.
Gusein-Zade**



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Singularities of Differentiable Maps Vladimir I. Arnol'd, 1985 *Singularities of Differentiable Maps, Volume 1* V.I. Arnold, S.M. Gusein-Zade, Alexander N. Varchenko, 2012-05-24 Singularity theory is a far reaching extension of maxima and minima investigations of differentiable functions with implications for many different areas of mathematics engineering catastrophe theory and the theory of bifurcations and science The three parts of this first volume of a two volume set deal with the stability problem for smooth mappings critical points of smooth functions and caustics and wave front singularities The second volume describes the topological and algebro geometrical aspects of the theory monodromy intersection forms oscillatory integrals asymptotics and mixed Hodge structures of singularities The first volume has been adapted for the needs of non mathematicians presupposing a limited mathematical background and beginning at an elementary level With this foundation the book's sophisticated development permits readers to explore more applications than previous books on singularities

Singularities of Differentiable Maps V.I. Arnold, Alexander Varchenko, S.M. Gusein-Zade, 1985-01-01 there is nothing so enthralling so grandiose nothing that stuns or captivates the human soul quite so much as a first course in a science After the first five or six lectures one already holds the brightest hopes already sees oneself as a seeker after truth I too have wholeheartedly pursued science passionately as one would a beloved woman I was a slave and sought no other sun in my life Day and night I crammed myself bending my back ruining myself over my books I wept when I beheld others exploiting science for personal gain But I was not long enthralled The truth is every science has a beginning but never an end they go on for ever like periodic fractions Zoology for example has discovered thirty five thousand forms of life A P Chekhov On the road In this book a start is made to the zoology of the singularities of differentiable maps This theory is a young branch of analysis which currently occupies a central place in mathematics it is the crossroads of paths leading from very abstract corners of mathematics such as algebraic and differential geometry and topology Lie groups and algebras complex manifolds commutative algebra and the like to the most applied areas such as differential equations and dynamical systems optimal control the theory of bifurcations and catastrophes short wave and saddle point asymptotics and geometrical and wave optics

Singularities of Differentiable Maps V.I. Arnold, A.N. Varchenko, S.M. Gusein-Zade, 2012-12-06 there is nothing so enthralling so grandiose nothing that stuns or captivates the human soul quite so much as a first course in a science After the first five or six lectures one already holds the brightest hopes already sees oneself as a seeker after truth I too have wholeheartedly pursued science passionately as one would a beloved woman I was a slave and sought no other sun in my life Day and night I crammed myself bending my back ruining myself over my books I wept when I beheld others exploiting science for personal gain But I was not long enthralled The truth is every science has a beginning but never an end they go on for ever like periodic fractions Zoology for example has discovered thirty five thousand forms of life A P Chekhov On the road In this book a start is made to the zoology of the singularities of differentiable maps This theory is a young

branch of analysis which currently occupies a central place in mathematics it is the crossroads of paths leading from very abstract corners of mathematics such as algebraic and differential geometry and topology Lie groups and algebras complex manifolds commutative algebra and the like to the most applied areas such as differential equations and dynamical systems optimal control the theory of bifurcations and catastrophes short wave and saddle point asymptotics and geometrical and wave optics

Singularities of Differentiable Maps - Vol. I: the Classification of Critical Points Caustics and Wave Fronts Vladimir Igorevic Arnold, 1985

Handbook of Geometry and Topology of Singularities VII José Luis Cisneros-Molina, Lê Dũng Tráng, José Seade, 2025-03-01 This is the seventh volume of the Handbook of Geometry and Topology of Singularities a series that aims to provide an accessible account of the state of the art of the subject its frontiers and its interactions with other areas of research This volume consists of fourteen chapters that provide an in depth and reader friendly introduction to various important aspects of singularity theory The volume begins with an outstanding exposition on Jim Damon's contributions to singularity theory and its applications Jim passed away in 2022 and he was one of the greatest mathematicians of recent times having made remarkable contributions to singularity theory and its applications mostly to medical image computing The next chapter focuses on the singularities of real functions and their bifurcation sets Then we look at the perturbation theory of polynomials and linear operators complex analytic frontal singularities the global singularity theory of differentiable maps and the singularities of holomorphic functions from a global point of view The volume continues with an overview of new tools in singularity theory that spring from symplectic geometry and Floer type homology theories Then it looks at the derivation of Lie algebras of isolated singularities and the three dimensional rational isolated complete intersection singularities as well as recent developments in algebraic K stability and the stable degeneration conjecture This volume also contains an interesting survey on V filtrations a theory began by Malgrange and Kashiwara that can be used to study nearby and vanishing cycle functors and introduced by Deligne Then we present a panoramic view of the Hodge toric and motivic methods in the study of Milnor fibers in singularity theory both from local and global points of view The Monodromy conjecture is also explained this is a longstanding open problem in singularity theory that lies at the crossroads of number theory algebra analysis geometry and topology This volume closes with recent developments in the study of the algebraic complexity of optimization problems in applied algebraic geometry and algebraic statistics The book is addressed to graduate students and newcomers to the theory as well as to specialists who can use it as a guidebook

Singularities of Differentiable Maps, Volume 2 Elionora Arnold, S.M. Gusein-Zade, Alexander N. Varchenko, 2012-05-16 The present volume is the second in a two volume set entitled Singularities of Differentiable Maps While the first volume subtitled Classification of Critical Points and originally published as Volume 82 in the Monographs in Mathematics series contained the zoology of differentiable maps that is it was devoted to a description of what where and how singularities could be encountered this second volume concentrates on elements of the anatomy and physiology of

singularities of differentiable functions The questions considered are about the structure of singularities and how they function

Applied Picard-Lefschetz Theory V. A. Vasil'ev, 2002 Many important functions of mathematical physics are defined as integrals depending on parameters The Picard Lefschetz theory studies how analytic and qualitative properties of such integrals regularity algebraicity ramification singular points etc depend on the monodromy of corresponding integration cycles In this book V A Vassiliev presents several versions of the Picard Lefschetz theory including the classical local monodromy theory of singularities and complete intersections Pham's generalized Picard Lefschetz formulas stratified Picard Lefschetz theory and also twisted versions of all these theories with applications to integrals of multivalued forms The author also shows how these versions of the Picard Lefschetz theory are used in studying a variety of problems arising in many areas of mathematics and mathematical physics In particular he discusses the following classes of functions volume functions arising in the Archimedes Newton problem of integrable bodies Newton Coulomb potentials fundamental solutions of hyperbolic partial differential equations multidimensional hypergeometric functions generalizing the classical Gauss hypergeometric integral The book is geared toward a broad audience of graduate students research mathematicians and mathematical physicists interested in algebraic geometry complex analysis singularity theory asymptotic methods potential theory and hyperbolic operators

Real and Complex Singularities Ana Claudia Nabarro, Juan J. Nuño-Ballesteros, Raúl Oset Sinha, Maria Aparecida Soares Ruas, 2016-10-25 This volume is a collection of papers presented at the XIII International Workshop on Real and Complex Singularities held from July 27 August 8 2014 in São Carlos Brazil in honor of María del Carmen Romero Fuster's 60th birthday The volume contains the notes from two mini courses taught during the workshop on intersection homology by J P Brasselet and on non isolated hypersurface singularities and L cycles by D Massey The remaining contributions are research articles which cover topics from the foundations of singularity theory including classification theory and invariants to topology of singular spaces links of singularities and semi algebraic sets as well as applications to topology cobordism and Lefschetz fibrations dynamical systems Morse Bott functions and differential geometry affine geometry Gauss maps caustics frontals and non Euclidean geometries This book is published in cooperation with Real Sociedad Matemática Española RSME

New Trends in Sub-Riemannian Geometry Fabrice Baudoin, Luca Rizzi, 2025-01-27 This volume contains the proceedings of the AMS EMS SMF Special Session on Sub Riemannian Geometry and Interactions held from July 18 20 2022 at the Université de Grenoble Alpes Grenoble France Sub Riemannian geometry is a generalization of Riemannian one where a smooth metric is defined only on a preferred subset of tangent directions Under the so called Hörmander condition all points are connected by finite length curves giving rise to a well defined metric space Sub Riemannian geometry is nowadays a lively branch of mathematics connected with probability harmonic and complex analysis subelliptic PDEs geometric measure theory optimal transport calculus of variations and potential analysis The articles in this volume present some developments of a broad range of topics in sub Riemannian geometry including the

theory of sub elliptic operators holonomy spectral theory and the geometry of the exponential map

Introduction to Lipschitz Geometry of Singularities Walter Neumann, Anne Pichon, 2021-01-11 This book presents a broad overview of the important recent progress which led to the emergence of new ideas in Lipschitz geometry and singularities and started to build bridges to several major areas of singularity theory Providing all the necessary background in a series of introductory lectures it also contains Pham and Teissier's previously unpublished pioneering work on the Lipschitz classification of germs of plane complex algebraic curves While a real or complex algebraic variety is topologically locally conical it is in general not metrically conical there are parts of its link with non trivial topology which shrink faster than linearly when approaching the special point The essence of the Lipschitz geometry of singularities is captured by the problem of building classifications of the germs up to local bi Lipschitz homeomorphism The Lipschitz geometry of a singular space germ is then its equivalence class in this category The book is aimed at graduate students and researchers from other fields of geometry who are interested in studying the multiple open questions offered by this new subject

Introduction to the h -Principle K. Cieliebak, Y. Eliashberg, N. Mishachev, 2024-01-30 In differential geometry and topology one often deals with systems of partial differential equations as well as partial differential inequalities that have infinitely many solutions whatever boundary conditions are imposed It was discovered in the 1950s that the solvability of differential relations i e equations and inequalities of this kind can often be reduced to a problem of a purely homotopy theoretic nature One says in this case that the corresponding differential relation satisfies the h principle Two famous examples of the h principle the Nash Kuiper C^1 isometric embedding theory in Riemannian geometry and the Smale Hirsch immersion theory in differential topology were later transformed by Gromov into powerful general methods for establishing the h principle The authors cover two main methods for proving the h principle holonomic approximation and convex integration The reader will find that with a few notable exceptions most instances of the h principle can be treated by the methods considered here A special emphasis is made on applications to symplectic and contact geometry The present book is the first broadly accessible exposition of the theory and its applications making it an excellent text for a graduate course on geometric methods for solving partial differential equations and inequalities Geometers topologists and analysts will also find much value in this very readable exposition of an important and remarkable topic This second edition of the book is significantly revised and expanded to almost twice of the original size The most significant addition to the original book is the new part devoted to the method of wrinkling and its applications Several other chapters e g on multivalued holonomic approximation and foliations are either added or completely rewritten

Handbook of Geometry and Topology of Singularities V: Foliations Felipe Cano, José Luis Cisneros-Molina, Lê Dũng Tráng, José Seade, 2024-06-05 This is the fifth volume of the Handbook of Geometry and Topology of Singularities a series which aims to provide an accessible account of the state of the art of the subject its frontiers and its interactions with other areas of research Singularities are ubiquitous in mathematics and science in general

and singularity theory is a crucible where different types of mathematical problems converge surprising connections are born and simple questions lead to ideas which resonate in other parts of the subject and in other subjects This Volume V focuses on singular holomorphic foliations which is a multidisciplinary field and a whole area of mathematics in itself Singular foliations arise for instance by considering The fibers of a smooth map between differentiable manifolds with singularities at the critical points The integral lines of a vector field or the action of a Lie group on a manifold The singularities are the orbits with special isotropy The kernel of appropriate 1 forms The singularities are the zeros of the form Open books which naturally appear in singularity theory as foliations with singular set the binding These important examples highlight the deep connections between foliations and singularity theory This volume like its companion Volume VI also focused on foliations consists of nine chapters authored by world experts which provide in depth and reader friendly introductions to some of the foundational aspects of the theory These introductions also give insights into important lines of further research The volume starts with a foreword by one of the current world leaders in the theory of complex foliations The book is addressed to graduate students and newcomers to the theory as well as to specialists who can use it as a guidebook *Singularities, Algebraic Geometry, Commutative Algebra, and Related Topics* Gert-Martin Greuel, Luis Narváez Macarro, Sebastià Xambó-Descamps, 2018-09-18 This volume brings together recent original research and survey articles by leading experts in several fields that include singularity theory algebraic geometry and commutative algebra The motivation for this collection comes from the wide ranging research of the distinguished mathematician Antonio Campillo in these and related fields Besides his influence in the mathematical community stemming from his research Campillo has also endeavored to promote mathematics and mathematicians networking everywhere especially in Spain Latin America and Europe Because of his impressive achievements throughout his career we dedicate this book to Campillo in honor of his 65th birthday Researchers and students from the world wide and in particular Latin American and European communities in singularities algebraic geometry commutative algebra coding theory and other fields covered in the volume will have interest in this book

Lectures on Analytic Differential Equations I. U. S. Il'iin, S. Yakovenko, 2008 The book combines the features of a graduate level textbook with those of a research monograph and survey of the recent results on analysis and geometry of differential equations in the real and complex domain As a graduate textbook it includes self contained sometimes considerably simplified demonstrations of several fundamental results which previously appeared only in journal publications desingularization of planar analytic vector fields existence of analytic separatrices positive and negative results on the Riemann Hilbert problem Ecalle Voronin and Martinet Ramis moduli solution of the Poincare problem on the degree of an algebraic separatrix etc As a research monograph it explores in a systematic way the algebraic decidability of local classification problems rigidity of holomorphic foliations etc Each section ends with a collection of problems partly intended to help the reader to gain understanding and experience with the material partly drafting demonstrations of the mor The

exposition of the book is mostly geometric though the algebraic side of the constructions is also prominently featured on several occasions the reader is introduced to adjacent areas such as intersection theory for divisors on the projective plane or geometric theory of holomorphic vector bundles with meromorphic connections The book provides the reader with the principal tools of the modern theory of analytic differential equations and intends to serve as a standard source for references in this area

Singularities and Foliations. Geometry, Topology and Applications Raimundo Nonato Araújo dos Santos, Aurélio Menegon Neto, David Mond, Marcelo J. Saia, Jawad Snoussi, 2018-03-21 This proceedings book brings selected works from two conferences the 2nd Brazil Mexico Meeting on Singularity and the 3rd Northeastern Brazilian Meeting on Singularities that were held in Salvador in July 2015 All contributions were carefully peer reviewed and revised and cover topics like Equisingularity Topology and Geometry of Singularities Topological Classification of Singularities of Mappings and more They were written by mathematicians from several countries including Brazil Spain Mexico Japan and the USA on relevant topics on Theory of Singularity such as studies on deformations Milnor fibration foliations Catastrophe theory and myriad applications Open problems are also introduced making this volume a must read both for graduate students and active researchers in this field

A Panorama of Discrepancy Theory William Chen, Anand Srivastav, Giancarlo Travaglini, 2014-10-07 This is the first work on Discrepancy Theory to show the present variety of points of view and applications covering the areas Classical and Geometric Discrepancy Theory Combinatorial Discrepancy Theory and Applications and Constructions It consists of several chapters written by experts in their respective fields and focusing on the different aspects of the theory Discrepancy theory concerns the problem of replacing a continuous object with a discrete sampling and is currently located at the crossroads of number theory combinatorics Fourier analysis algorithms and complexity probability theory and numerical analysis This book presents an invitation to researchers and students to explore the different methods and is meant to motivate interdisciplinary research

Differential Geometry from a Singularity Theory Viewpoint Shyuichi E. T. Al IZUMIYA, 2015-10-29 Differential Geometry from a Singularity Theory Viewpoint provides a new look at the fascinating and classical subject of the differential geometry of surfaces in Euclidean spaces The book uses singularity theory to capture some key geometric features of surfaces It describes the theory of contact and its link with the theory of caustics and wavefronts It then uses the powerful techniques of these theories to deduce geometric information about surfaces embedded in 3 4 and 5 dimensional Euclidean spaces The book also includes recent work of the authors and their collaborators on the geometry of sub manifolds in Minkowski spaces

Real and Complex Singularities Marcelo José Saia, José Seade, 2008 This book offers a selection of papers based on talks at the Ninth International Workshop on Real and Complex Singularities a series of biennial workshops organized by the Singularity Theory group at Sao Carlos S P Brazil The papers deal with all the different topics in singularity theory and its applications from pure singularity theory related to commutative algebra and algebraic geometry to those topics associated with various

aspects of geometry to homotopy theory *Integrability, Quantization, and Geometry: I. Integrable Systems* Sergey Novikov, Igor Krichever, Oleg Ogievetsky, Senya Shlosman, 2021-04-12 This book is a collection of articles written in memory of Boris Dubrovin 1950-2019. The authors express their admiration for his remarkable personality and for the contributions he made to mathematical physics. For many of the authors, Dubrovin was a friend, colleague, inspiring mentor, and teacher. The contributions to this collection of papers are split into two parts: Integrable Systems and Quantum Theories and Algebraic Geometry, reflecting the areas of main scientific interests of Dubrovin. Chronologically, these interests may be divided into several parts: integrable systems, integrable systems of hydrodynamic type, WDVV equations, Frobenius manifolds, isomonodromy equations, flat connections, and quantum cohomology. The articles included in the first part are more or less directly devoted to these areas, primarily with the first three listed above. The second part contains articles on quantum theories and algebraic geometry and is less directly connected with Dubrovin's early interests.

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Introduction

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