

## Curves And Singularities A Geometrical Introduction To Singularity Theory

This book addresses the global study of finite and infinite singularities of planar polynomial differential systems, with special emphasis on quadratic systems. While results covering the degenerate cases of singularities of quadratic systems have been published elsewhere, the proofs for the remaining harder cases were lengthier. This book covers all cases, with half of the content focusing on the last non-degenerate ones. The book contains the complete bifurcation diagram, in the 12-parameter space, of global geometrical configurations of singularities of quadratic systems. The authors' results provide - for the first time - global information on all singularities of quadratic systems in invariant form and their bifurcations. In addition, a link to a very helpful software package is included. With the help of this software, the study of the algebraic bifurcations becomes much more efficient and less time-consuming. Given its scope, the book will appeal to specialists on polynomial differential systems, pure and applied mathematicians who need to study bifurcation diagrams of families of such systems, Ph.D. students, and postdoctoral fellows.

This is the second part of the Proceedings of the meeting 'School and Workshop on the Geometry and Topology of Singularities', held in Cuernavaca, Mexico, from January 8th to 26th of 2007, in celebration of the 60th Birthday of Le Dung Trang. This volume contains fourteen cutting-edge research articles on geometric and topological aspects of singularities of spaces and maps. By reading this volume, and the accompanying volume on algebraic and analytic aspects of singularities, the reader should gain an appreciation for the depth, breadth, and beauty of the subject, and also find a rich source of questions and problems for future study.

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.

This second edition is an invaluable textbook for anyone who would like an introduction to the modern theories of catastrophes and singularities.

This volume constitutes the thoroughly refereed post-conference proceedings of the 8th International Conference on Curves and Surfaces, held in Paris, France, in June 2014. The conference had the overall theme: "Representation and Approximation of Curves and Surfaces and Applications". The 32 revised full papers presented were carefully reviewed and selected from 39 submissions. The scope of the conference was on following topics: approximation theory, computer-aided geometric design, computer graphics and visualization, computational geometry and topology, geometry processing, image and signal processing, interpolation and smoothing, mesh generation, finite elements and splines, scattered data processing and learning theory, sparse and high-dimensional approximation, subdivision, wavelets and multi-resolution method.

This volume contains invited expository and research papers from the conference Topology of Algebraic Varieties, in honor of Anatoly Libgober's 60th birthday, held June 22-26, 2009, in Jaca, Spain. The volume contains four parts corresponding to the four main focal points of the conference: algebraic geometry and fundamental groups, braids and knots, hyperplane arrangements, and singularities. Together, the papers provide an overview of the current status of a broad range of topological questions in Algebraic Geometry.

Interest in the study of geometry is currently enjoying a resurgence-understandably so, as the study of curves was once the playground of some very great mathematicians. However, many of the subject's more exciting aspects require a somewhat advanced mathematics background. For the "fun stuff" to be accessible, we need to offer students an introduction with modest prerequisites, one that stimulates their interest and focuses on problem solving. Integrating parametric, algebraic, and projective curves into a single text, *Geometry of Curves* offers students a unique approach that provides a mathematical structure for solving problems, not just a catalog of theorems. The author begins with the basics, then takes students on a fascinating journey from conics, higher algebraic and transcendental curves, through the properties of parametric curves, the classification of limaçons, envelopes, and finally to projective curves, their relationship to algebraic curves, and their application to asymptotes and boundedness. The uniqueness of this treatment lies in its integration of the different types of curves, its use of analytic methods, and its generous number of examples, exercises, and illustrations. The result is a practical text, almost entirely self-contained, that not only imparts a deeper understanding of the theory, but inspires a heightened appreciation of geometry and interest in more advanced studies.

"Presents the structure of algebras appearing in representation theory of groups and algebras with general ring theoretic methods related to representation theory. Covers affine algebraic sets and the nullstellensatz, polynomial and rational functions, projective algebraic sets. Groebner basis, dimension of algebraic sets, local theory, curves and elliptic curves, and more."

Geometric Modeling and Algebraic Geometry, though closely related, are traditionally represented by two almost disjoint scientific communities. Both fields deal with objects defined by algebraic equations, but the objects are studied in different ways. In 12 chapters written by leading experts, this book presents recent results which rely on the interaction of both fields. Some of these results have been obtained from a major European project in geometric modeling.

This volume contains the proceedings of an AMS special session held at the 1999 Joint Mathematics Meetings in San Antonio. The participants were an international group of researchers studying singularities from algebraic and analytic viewpoints. The contributed papers contain original results as well as some expository and historical material. This volume is dedicated to Oscar Zariski, on the one hundredth anniversary of his birth. The topics include the role of valuation theory in algebraic geometry with recent applications to the structure of morphisms; algorithmic approaches to resolution of equisingular surface singularities and locally toric varieties; weak subintegral closures of ideals and Rees valuations; constructions of universal weakly subintegral extensions of rings; direct-sum decompositions of finitely generated modules; construction and examples of resolution graphs of surface singularities; Jacobians of meromorphic curves; investigation of spectral numbers of curve singularities using Puiseux pairs; Grobner basis calculations of Hochschild homology for hypersurfaces with isolated singularities; and the theory of characteristic classes of singular spaces - a brief history with conjectures and open problems.

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.

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 Lê 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)

Comprehensive and self-contained exposition of singularities of plane curves, including new, previously unpublished results. 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.

In image processing, "motions by curvature" provide an efficient way to smooth curves representing the boundaries of objects. In such a motion, each point of the curve moves, at any instant, with a normal velocity equal to a function of the curvature at this point. This book is a rigorous and self-contained exposition of the techniques of "motion by curvature". The approach is axiomatic and formulated in terms of geometric invariance with respect to the position of the observer. This is translated into mathematical terms, and the author develops the approach of Olver, Sapiro and Tannenbaum, which classifies all curve evolution equations. He then draws a complete parallel with another axiomatic approach using level-set methods: this leads to generalized curvature motions. Finally, novel, and very accurate, numerical schemes are proposed allowing one to compute the solution of highly degenerate evolution equations in a completely invariant way. The convergence of this scheme is also proved.

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The Advances in Architectural Geometry (AAG) symposia serve as a unique forum where developments in the design, analysis and fabrication of building geometry are presented. With participation of both academics and professionals, each symposium aims to gather and present practical work and theoretical research that responds to contemporary design challenges and expands the opportunities for architectural form. The fifth edition of the AAG symposia was hosted by the National Centre for Competence in Research Digital Fabrication at ETH Zurich, Switzerland, in September 2016. This book contains the proceedings from the AAG2016 conference and offers detailed insight into current and novel geometrical developments in architecture. The 22 diverse, peer-reviewed papers present cutting-edge innovations in the fields of mathematics, computer graphics, software design, structural engineering, and the design and construction of architecture.

Collection of popular articles on geometry from distinguished mathematicians and educationalists.

The first monograph on singularities of mappings for many years, this book provides an introduction to the subject and an account of recent developments concerning the local structure of complex analytic mappings. Part I of the book develops the now classical real  $C^k$  and complex analytic theories jointly. Standard topics such as stability, deformation theory and finite determinacy, are covered in this part. In Part II of the book, the authors focus on the complex case. The treatment is centred around the idea of the "nearby stable object" associated to an unstable map-germ, which includes in particular the images and discriminants of stable perturbations of unstable singularities. This part includes recent research results, bringing the reader up to date on the topic. By focusing on singularities of mappings, rather than spaces, this book provides a necessary addition to the literature. Many examples and exercises, as well as appendices on background material, make it an invaluable guide for graduate students and a key reference for researchers. A number of graduate level courses on singularities of mappings could be based on the material it contains.

This ENCYCLOPAEDIA OF MATHEMATICS aims to be a reference work for all parts of mathematics. It is a translation with updates and editorial comments of the Soviet Mathematical Encyclopaedia published by 'Soviet Encyclopaedia Publishing House' in five volumes in 1977 - 1985. The annotated translation consists of ten volumes including a special index volume. There are three kinds of articles in this ENCYCLOPAEDIA. First of all there are survey-type articles dealing with the various main directions in mathematics (where a rather fine subdivision has been used). The main requirement for these articles has been that they should give a reasonably complete up-to-date account of the current state of affairs in these areas and that they should be maximally accessible. On the whole, these articles should be understandable to mathematics students in their first specialization years, to graduates from other mathematical areas and, depending on the specific subject, to specialists in other domains of science, engineers and teachers of mathematics. These articles treat their material at a fairly general level and aim to give an idea of the kind of problems, techniques and concepts involved in the area in question. They also contain background and motivation rather than precise statements of precise theorems with detailed definitions and technical details on how to carry out proofs and constructions. The second kind of article, of medium length, contains more detailed concrete problems, results and techniques. Singularity theory appears in numerous branches of mathematics, as well as in many emerging areas such as robotics, control theory, imaging, and various evolving areas in physics. The purpose of this proceedings volume is to cover recent developments in singularity theory and to introduce young researchers from developing countries to singularities in geometry and topology. The contributions discuss singularities in both complex and real geometry. As such, they provide a natural continuation of the previous school on singularities held at ICTP (1991), which is recognized as having had a major influence in the field.

This book presents the proceedings of two conferences, Resolution des singularites et geometrie non commutative and the Annapolis Algebraic Geometry Conference. Research articles in the volume cover various topics of algebraic geometry, including the theory of Jacobians, singularities, applications to cryptography, and more. The book is suitable for graduate students and research mathematicians interested in algebraic geometry.

The series is aimed specifically at publishing peer reviewed reviews and contributions presented at workshops and conferences. Each volume is associated with a particular conference, symposium or workshop. These events cover various topics within pure

and applied mathematics and provide up-to-date coverage of new developments, methods and applications.

The differential geometry of curves and surfaces in Euclidean space has fascinated mathematicians since the time of Newton. Here the authors take a novel approach by casting the theory into a new light, that of singularity theory. The second edition of this successful textbook has been thoroughly revised throughout and includes a multitude of new exercises and examples. A new final chapter has been added that covers recently developed techniques in the classification of functions of several variables, a subject central to many applications of singularity theory. Also in this second edition are new sections on the Morse lemma and the classification of plane curve singularities. The only prerequisites for students to follow this textbook are a familiarity with linear algebra and advanced calculus. Thus it will be invaluable for anyone who would like an introduction to the modern theories of catastrophes and singularities.

Since the beginning of human history we have had a communication network that is identical with the physical distribution network. In the late 19th century we established the energy network to distribute electric and thermal energy, launching the modern society. The analog communication network became popular in the middle of the 20th century. And now, at the end of the 20th century, we have global digital information networks. Along with the advancement of the communication network, the progress of the information processing technology can be classified into three historical phases. The first phase technology is physical information processing, treating physical data from the real world. This technology is often called "signal processing" and is based on the physical law of nature. The second phase is free from the physical constraints. It is logical information processing, dealing with knowledge and rules. The most important aspect of this phase is consistency. "Provable" is employed to confirm the reality of the system. Based on the advanced computer and network technology, we are entering the third phase of information processing, which is "Kansei" information processing. ("Kansei" is a Japanese word expressing some subjective ability referred to as "sensitivity", "intuition", "affection" or "emotion"). Emotional resonance or consent is important in the pursuit of reality in this phase. Multimedia modeling to harmonize different media and systems is one of the key technologies in the third phase of information processing. It will provide a next generation framework to construct a human-centered information environment that is more comfortable and more productive. This volume is devoted to a discussion on effective modeling of multimedia information and systems for a wide range of applications. It contains 30 technical articles, all of which were selected, after vigorous peer reviews, for presentation at the International Conference on Multimedia Modeling held in Nagano, Japan, on 13-15 November 2000.

Geometry, this very ancient field of study of mathematics, frequently remains too little familiar to students. Michle Audin, professor at the University of Strasbourg, has written a book allowing them to remedy this situation and, starting from linear algebra, extend their knowledge of affine, Euclidean and projective geometry, conic sections and quadrics, curves and surfaces. It includes many nice theorems like the nine-point circle, Feuerbach's theorem, and so on. Everything is presented clearly and rigorously. Each property is proved, examples and exercises illustrate the course content perfectly. Precise hints for most of the exercises are provided at the end of the book. This very comprehensive text is addressed to students at upper undergraduate and Master's level to discover geometry and deepen their knowledge and understanding.

A collection of articles giving overviews and open questions in singularities and their computational aspects.

This book contains expository papers that give an up-to-date account of recent developments and open problems in the geometry and topology of manifolds, along with several research articles that present new results appearing in published form for the first time. The unifying theme is the problem of understanding manifolds in low dimensions, notably in dimensions three and four, and the techniques include algebraic topology, surgery theory, Donaldson and Seiberg-Witten gauge theory, Heegaard Floer homology, contact and symplectic geometry, and Gromov-Witten invariants. The articles collected for this volume were contributed by participants of the Conference "Geometry and Topology of Manifolds" held at McMaster University on May 14-18, 2004 and are representative of the many excellent talks delivered at the conference.

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. Contents: The Case for the Singularity Theory Approach Submanifolds of the Euclidean Space Singularities of Germs of Smooth Mappings Contact Between Submanifolds of  $n$ -Lagrangian and Legendrian Singularities Surfaces in the Euclidean 3-Space Surfaces in the Euclidean 4-Space Surfaces in the Euclidean 5-Space Spacelike Surfaces in the Minkowski Space-Time Global Viewpoint Readership: Advanced undergraduates and post-graduate students, and researchers in the fields of differential geometry and singularity theory. Key Features: The book is unique in its nature. It provides a coherent approach for studying the geometry of sub-manifolds of various ambient spaces from the singularity theory point of view. The book informs the reader about the progress in the field of extrinsic differential geometry and singularity theory. The information is new and has not been treated in previous textbooks. The book gathers scattered work from various research articles, most of which are recent, and describes techniques that could be used to tackle problems in other areas of mathematics. Keywords: Contact; Extrinsic Geometry; Genericity; Caustics; Singularities; Surfaces; Transversality; Wave Fronts

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