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Numerical Geometry of Images examines computational methods and algorithms in image processing. It explores applications like shape from shading, color-image enhancement and segmentation, edge integration, offset curve computation, symmetry axis computation, path planning, minimal geodesic computation, and invariant signature calculation. In addition, it describes and utilizes tools from mathematical morphology, differential geometry, numerical analysis, and calculus of variations. Graduate students, professionals, and researchers with interests in computational geometry, image processing, computer graphics, and algorithms will find this new text / reference an indispensable source of insight of instruction. Geometric algebra (a Clifford Algebra) has been applied to different branches of physics for a long time but is now being adopted by the computer graphics community and is providing exciting new ways of solving 3D geometric problems. The author tackles this complex subject with inimitable style, and provides an accessible and very readable introduction. The book is filled with lots of clear examples and is very well illustrated. Introductory chapters look at algebraic axioms, vector algebra and geometric conventions and the book closes with a chapter on how the algebra is applied to computer graphics. Data structures and tools from computational geometry help to solve problems in computer graphics; these methods have been widely adopted by the computer graphics community yielding elegant and efficient algorithms. This book focuses on algorithms and data structures that have proven to be versatile, efficient, fundamental, and easy to implement. The book familiarizes students, as well as practitioners in the field of computer graphics, with a wide range of data structures. The authors describe each data structure in detail, highlight fundamental properties, and present algorithms based on the data structure. A number of recent representative and useful algorithms from computer graphics are described in detail, illuminating the utilization of the data structure in a creative way. John Vince explains a wide range of mathematical techniques and problem-solving strategies associated with computer games, computer animation, virtual reality, CAD, and other areas of computer graphics. Covering all the mathematical techniques required to resolve geometric problems and design computer programs for computer graphic applications, each chapter explores a specific mathematical topic prior to moving forward into the more advanced areas of matrix transforms, 3D curves and surface patches. Problem-solving techniques using vector analysis and geometric algebra are also discussed. All the key areas are covered including: Numbers, Algebra, Trigonometry, Coordinate geometry, Transforms, Vectors, Curves and surfaces, Barycentric coordinates, Analytic geometry. Plus – and unusually in a student textbook – a chapter on geometric algebra is included. John Vince explains a comprehensive range of mathematical techniques and problem-solving strategies associated with computer games, computer animation, special effects, virtual reality, CAD and other areas of computer graphics in this completely revised and expanded sixth edition. The first five chapters cover a general introduction, number sets, algebra, trigonometry and coordinate systems, which are employed in the following chapters on determinants, vectors, matrix algebra, complex numbers, geometric transforms, quaternion algebra, quaternions in space, interpolation, curves and patches, analytical geometry and barycentric coordinates. Following this, the reader is introduced to the relatively new subject of geometric algebra, followed by two chapters that introduce differential and integral calculus. Finally, there is a chapter on worked examples. Mathematics for Computer Graphics covers all of the key areas of the subject, including: • Number sets • Algebra • Trigonometry • Complex numbers • Coordinate systems • Determinants • Vectors • Quaternions • Matrix algebra • Geometric transforms • Interpolation • Curves and surfaces • Analytic geometry • Barycentric coordinates • Geometric algebra •

Differential calculus • Integral calculus This sixth edition contains approximately 150 worked examples and over 330 colour illustrations, which are central to the author ' s descriptive writing style. Mathematics for Computer Graphics provides a sound understanding of the mathematics required for computer graphics software and setting the scene for further reading of more advanced books and technical research papers As an introduction to fundamental geometric concepts and tools needed for solving problems of a geometric nature using a computer, this book fills the gap between standard geometry books, which are primarily theoretical, and applied books on computer graphics, computer vision, or robotics that do not cover the underlying geometric concepts in detail. Gallier offers an introduction to affine, projective, computational, and Euclidean geometry, basics of differential geometry and Lie groups, and explores many of the practical applications of geometry. Some of these include computer vision, efficient communication, error correcting codes, cryptography, motion interpolation, and robot kinematics. This comprehensive text covers most of the geometric background needed for conducting research in computer graphics, geometric modeling, computer vision, and robotics and as such will be of interest to a wide audience including computer scientists, mathematicians, and engineers. Deformable objects are ubiquitous in the world surrounding us, on all levels from micro to macro. The need to study such shapes and model their behavior arises in a wide spectrum of applications, ranging from medicine to security. In recent years, non-rigid shapes have attracted growing interest, which has led to rapid development of the field, where state-of-the-art results from very different sciences - theoretical and numerical geometry, optimization, linear algebra, graph theory, machine learning and computer graphics, to mention several - are applied to find solutions. This book gives an overview of the current state of science in analysis and synthesis of non-rigid shapes. Everyday examples are used to explain concepts and to illustrate different techniques. The presentation unfolds systematically and numerous figures enrich the engaging exposition. Practice problems follow at the end of each chapter, with detailed solutions to selected problems in the appendix. A gallery of colored images enhances the text. This book will be of interest to graduate students, researchers and professionals in different fields of mathematics, computer science and engineering. It may be used for courses in computer vision, numerical geometry and geometric modeling and computer graphics or for self-study. Possibly the most comprehensive overview of computer graphics as seen in the context of geometric modeling, this two-volume work covers implementation and theory in a thorough and systematic fashion. It covers the computer graphics part of the field of geometric modeling and includes all the standard computer graphics topics. The CD-ROM features two companion programs. This book constitutes the thoroughly refereed proceedings of the 18th International Conference on Discrete Geometry for Computer Imagery, DGCI 2014, held in Siena, Italy, September 2014. The 34 revised full papers presented were carefully selected from 60 submissions. The papers are organized in topical sections on Models for Discrete Geometry, Discrete and Combinatorial Topology, Geometric Transforms, Discrete Shape Representation, Recognition and Analysis, Discrete Tomography, Morphological Analysis, Discrete Modelling and Visualization, Discrete and Combinatorial Tools for Image Segmentation and Analysis. This 2005 book deals with interest topics in Discrete and Algorithmic aspects of Geometry. This book introduces the fundamentals of computer vision (CV), with a focus on extracting useful information from digital images and videos. Including a wealth of methods used in detecting and classifying image objects and their shapes, it is the first book to apply a trio of tools (computational geometry, topology and algorithms) in solving CV problems, shape tracking in image object recognition and detecting the repetition of shapes in single images and video frames. Computational geometry provides a visualization of topological structures such as neighborhoods of points embedded in images, while image topology supplies us with structures useful in the analysis and classification of image regions. Algorithms provide a practical, step-by-step means of viewing image structures. The implementations of CV methods in Matlab and Mathematica, classification of chapter problems with the symbols (easily solved) and (challenging) and its extensive glossary of key words, examples and connections with the fabric of CV make the book an invaluable resource for advanced undergraduate and first year graduate students in Engineering, Computer Science or Applied Mathematics. It offers insights into the design of CV experiments, inclusion of image processing methods in CV projects, as well as the reconstruction and interpretation of recorded natural scenes. This textbook offers a statistical view on the geometry of multiple view analysis, required for camera calibration and orientation and for geometric scene reconstruction based on geometric image features. The authors have backgrounds in geodesy and also long experience with development and research in computer vision, and this is the first book to present a joint approach from the converging fields of photogrammetry and computer vision. Part I of the book provides an introduction to estimation theory, covering aspects such as Bayesian estimation, variance components, and sequential estimation, with a focus on the statistically sound diagnostics of estimation results essential in vision metrology. Part II provides tools for 2D and 3D geometric reasoning using projective geometry. This includes oriented projective geometry and tools for statistically optimal estimation and test of geometric entities and transformations and their relations, tools that are useful also in the context of uncertain reasoning in point clouds. Part III is devoted to modelling the geometry of single and multiple cameras, addressing calibration and orientation, including statistical evaluation and reconstruction of corresponding scene features and surfaces based on geometric image features. The authors provide algorithms for various geometric computation problems in vision metrology, together with mathematical justifications and statistical analysis, thus enabling thorough evaluations. The chapters are self-contained with numerous figures and exercises, and they are supported by an appendix that explains the basic mathematical notation and a detailed index. The book can serve as the basis for undergraduate and graduate courses in photogrammetry, computer vision, and computer graphics. It is also appropriate for researchers, engineers, and software developers in the photogrammetry and GIS industries, particularly those engaged with statistically based geometric computer vision methods. Focusing on the manipulation and representation of geometrical objects, this book explores the application of geometry to computer graphics and computer-aided design (CAD). Over 300 exercises are included, some new to this edition, and many of which encourage the reader to implement the techniques and algorithms discussed through the use of a computer package with graphing and computer algebra capabilities. A dedicated website also offers further resources and useful links. This book provides comprehensive coverage of the modern methods for geometric problems in the computing sciences. It also covers concurrent topics in data sciences including geometric processing, manifold learning, Google search, cloud data, and R-tree for wireless networks and BigData. The author investigates digital geometry and its related constructive methods in discrete geometry, offering detailed methods and algorithms. The book is divided into five sections: basic geometry; digital curves, surfaces and manifolds; discretely represented objects; geometric computation and processing; and advanced topics. Chapters especially focus on the applications of these methods to other types of geometry, algebraic topology, image processing, computer vision and computer graphics. Digital and Discrete Geometry: Theory and Algorithms targets researchers and professionals working in digital image processing analysis, medical imaging (such as CT and MRI) and informatics, computer graphics, computer vision, biometrics, and information theory. Advanced-level students in electrical engineering, mathematics, and computer science will also find this book useful as a secondary text book or reference. Praise for this book: This book does present a large collection of important concepts, of mathematical, geometrical, or algorithmical nature, that are frequently used in computer graphics and image processing. These concepts range from graphs through manifolds to homology. Of particular value are the sections dealing with discrete versions of classic continuous notions. The reader finds compact definitions and concise explanations that often appeal to intuition, avoiding finer, but then necessarily more complicated, arguments... As a first introduction, or as a reference for professionals working in computer graphics or image processing, this book should be of considerable value." - Prof. Dr. Rolf Klein, University of Bonn. This book constitutes the refereed proceedings of the 6th International Workshop on Discrete Geometry for Computer Imagery, DGCI'96, held in Lyon, France, in November 1996. Computer imaging essentially depends on discrete models for coding, processing, recognition, representation, etc. The volume presents 24 revised full papers selected from 41 submissions together with 3 invited contributions and a tutorial paper, which bridges the gap between theory and practice. The issues addressed are topology, geometry, shape representation, 3D surfaces and volumes, models for discrete space, image transformation and generation. Digital geometry is about deriving geometric information from digital pictures. The field emerged from its mathematical roots some forty-years ago through work in computer-based imaging, and it is used today in many fields, such as digital image processing and analysis (with applications in medical imaging, pattern recognition, and robotics) and of course computer graphics. Digital Geometry is the first book to detail the concepts, algorithms, and practices of the discipline. This comphrehensive text and reference provides an introduction to the mathematical foundations of digital geometry, some of which date back to ancient times, and also discusses the key processes involved, such as geometric algorithms as well as operations on pictures. *A comprehensive text and reference written by pioneers in digital geometry, image processing and analysis, and computer vision *Provides a collection of state-of-the-art algorithms for a wide variety of geometrical picture analysis tasks, including extracting data from digital images and making geometric measurements on the data *Includes exercises, examples, and references to related or more advanced work Spectral Geometry of Shapes presents unique shape analysis approaches based on shape spectrum in differential geometry. It provides insights on how to develop geometry-based methods for 3D shape analysis. The book is an ideal learning resource for graduate students and researchers in computer science, computer engineering and applied mathematics who have an interest in 3D shape analysis, shape motion analysis, image analysis, medical image analysis, computer vision and computer graphics. Due to the rapid advancement of 3D acquisition technologies there has been a big increase in 3D shape data that requires a variety of shape analysis methods, hence the need for this comprehensive resource. Presents the latest advances in spectral geometric processing for 3D shape analysis applications, such as shape classification, shape matching, medical imaging, etc. Provides intuitive links between fundamental geometric theories and real-world applications, thus bridging the gap between theory and practice Describes new theoretical breakthroughs in applying spectral methods for non-isometric motion analysis Gives insights for developing spectral geometry-based approaches for 3D shape analysis and deep learning of shape geometry A Sampler of Useful Computational Tools for Applied Geometry, Computer Graphics, and Image Processing shows how to use a collection of mathematical techniques to solve important problems in applied mathematics and computer science areas. The book discusses fundamental tools in analytical geometry and linear algebra. It covers a wide range of topics These proceedings contain papers presented at the 8th Discrete Geometry for Computer Imagery conference, held 17-19, March 1999 at ESIEE, Marne-la- Vall ee. The domains of discrete geometry and computer imagery are closely related. Discrete geometry provides both theoretical and algorithmic models for the p- cessing, analysis and synthesis of images; in return computer imagery, in its variety of applications, constitutes a remarkable experimentational eld and is a source of challenging problems. The number of returning participants, the arrival each year of contributions from new laboratories and new researchers, as well as the quality and originality of the results have contributed to the success of the conference and are an - dication of the dynamism of this eld. The DGCI has become one of the major conferences related to this topic, including participating researchers and la- ratories from all over the world. Of the 41 papers received this year, 24 have been selected for presentation and 7 for poster sessions. In addition to these, four invited speakers have contributed to the conference. The site of Marne-la-Vall ee, just 20 min away from Paris, is particularly we- suited to hold the conference. Indeed, as a newly built city, it showcases a great amount of modern creative architecture, whose pure lines and original shapes o er a favorable context for the topic of Geometry. Stressing the interplay between theory and its practice, this text presents the construction of linear models that satisfy geometric postulate systems and develops geometric topics in computer graphics. It includes a computer graphics utility library of specialized subroutines on a 3.5 disk, designed for use with Turbo PASCAL 4.0 (or later version) - an effective means of computer-aided instruction for writing graphics problems.;Providing instructors with maximum flexibility that allows for the mathematics or computer graphics sections to be taught independently, this book: reviews linear algebra and notation, focusing on ideas of geometric significance that are often omitted in general purpose linear algebra courses; develops symmetric bilinear forms through classical results, including the inertia theorem, Witt's cancellation theorem and the unitary diagonalization of symmetric matrices; examines the Klein Erlanger programm, constructing models of geometries, and studying associated transformation groups; clarifies how to construct geometries from groups, encompassing topological notions; and introduces topics in computer graphics, including geometric modeling, surface rendering and transformation groups. The ultimate goal of all 3D graphics systems is to render 3D objects on a two-dimensional surface such as plotter output or a workstation screen. The approach adopted by most graphics systems is to perform a central or parallel projection of the objects onto the view surface. These systems have to make use of the mathematical results of projective geometry. This monograph has as its aim the derivation of a framework for analyzing the behavior of projective transformations in graphics systems. It is shown that a mathematically precise description of the projective geometrical nature of a graphics system leads not only to a deeper understanding of the system but also to new approaches which result in faster or more precise algorithms. A further aim of the book is to show the importance of advanced mathematics for computer science. Many problems become easier to describe or to solve when the appropriate mathematical tools are used. The author demonstrates that projective geometry has a major role to play in computer graphics. A complete overview of the geometry associated with computer graphics that provides everything a reader needs to understand the topic. Includes a summary hundreds of formulae used to solve 2D and 3D geometric problems; worked examples; proofs; mathematical strategies for solving geometric problems; a glossary of terms used in geometry. Turtle Geometry presents an innovative program of mathematical discovery that demonstrates how the effective use of personal computers can profoundly change the nature of a student's contact with mathematics. Using this book and a few simple computer programs, students can explore the properties of space by following an imaginary turtle across the screen. The concept of turtle geometry grew out of the Logo Group at MIT. Directed by Seymour Papert, author of Mindstorms, this group has done extensive work with preschool children, high school students and university undergraduates. This book constitutes the refereed proceedings of the 10th International Conference on Digital Geometry for Computer Imagery, DGCI 2002, held in Bordeaux, France, in April 2002. The 22 revised full papers and 13 posters presented together with 3 invited papers were carefully reviewed and selected from 67 submissions. The papers are organized in topical sections on topology, combinatorial image analysis, morphological analysis, shape representation, models for discrete geometry, segmentation and shape recognition, and applications. Until recently, almost all of the interactions between objects in virtual 3D worlds have been based on calculations performed using linear algebra. Linear algebra relies heavily on coordinates, however, which can make many geometric programming tasks very specific and complex-often a lot of effort is required to bring about even modest performance enhancements. Although linear algebra is an efficient way to specify low-level computations, it is not a suitable high-level language for geometric programming. Geometric Algebra for Computer Science presents a compelling alternative to the limitations of linear algebra. Geometric algebra, or GA, is a compact, time-effective, and performance-enhancing way to represent the geometry of 3D objects in computer programs. In this book you will find an introduction to GA that will give you a strong grasp of its relationship to linear algebra and its significance for your work. You will learn how to use GA to represent objects and perform geometric operations on them. And you will begin mastering proven techniques for making GA an integral part of your applications in a way that simplifies your code without slowing it down. * The first book on Geometric Algebra for programmers in computer graphics and entertainment computing * Written by leaders in the field providing essential information on this new technique for 3D graphics * This full colour book includes a website with GAViewer, a program to experiment with GA Computational geometry as an area of research in its own right emerged in the early seventies of this century. Right from the beginning, it was obvious that strong connections of various kinds exist to questions studied in the considerably older field of combinatorial geometry. For example, the combinatorial structure of a geometric problem usually decides which algorithmic method solves the problem most efficiently. Furthermore, the analysis of an algorithm often requires a great deal of combinatorial knowledge. As it turns out, however, the connection between the two research areas commonly referred to as computa tional geometry and combinatorial geometry is not as lop-sided as it appears. Indeed, the interest in computational issues in geometry gives a new and con structive direction to the combinatorial study of geometry. It is the intention of this book to demonstrate that computational and com binatorial investigations in geometry are doomed to profit from each other. To reach this goal, I designed this book to consist of three parts, acorn binatorial part, a computational part, and one that presents applications of the results of the first two parts. The choice of the topics covered in this book was guided by my attempt to describe the most fundamental algorithms in computational geometry that have an interesting combinatorial structure. In this early stage geometric transforms played an important role as they reveal connections between seemingly unrelated problems and thus help to structure the field. This book provides an accessible introduction to methods in computational geometry and computer graphics. It emphasizes the efficient object-oriented implemenation of geometric methods with useable C++ code for all methods discussed. This is the revised and expanded 1998 edition of a popular introduction to the design and implementation of geometry algorithms arising in areas such as computer graphics, robotics, and engineering design. The basic techniques used in computational geometry are all covered: polygon triangulations, convex hulls, Voronoi diagrams, arrangements, geometric searching, and motion planning. The self-contained treatment presumes only an elementary knowledge of mathematics, but reaches topics on the frontier of current research, making it a useful reference for practitioners at all levels. The second edition contains material on several new topics, such as randomized algorithms for polygon triangulation, planar point location, 3D convex hull construction, intersection algorithms for ray-segment and ray-triangle, and point-in-polyhedron. The code in this edition is significantly improved from the first edition (more efficient and more robust), and four new routines are included. Java versions for this new edition are also available. All code is accessible from the book's Web site (http://cs.smith.edu/~orourke/) or by anonymous ftp. This introduction to computational geometry focuses on algorithms. Motivation is provided from the application areas as all techniques are related to particular applications in robotics, graphics, CAD/CAM, and geographic information systems. Modern insights in computational geometry are used to provide solutions that are both efficient and easy to understand and implement. A complete overview of the geometry associated with computer graphics that provides everything a reader needs to understand the topic. Includes a summary hundreds of formulae used to solve 2D and 3D geometric problems; worked examples; proofs; mathematical strategies for solving geometric problems; a glossary of terms used in geometry. The International Workshop CG '88 on "Computational Geometry" was held at the University of W ü rzburg, FRG, March 24-25, 1988. As the interest in the fascinating field of Computational Geometry and its Applications has grown very quickly in recent years the organizers felt the need to have a workshop, where a suitable number of invited participants could concentrate their efforts in this field to cover a broad spectrum of topics and to communicate in a stimulating atmosphere. This workshop was attended by some fifty invited scientists. The scientific program consisted of 22 contributions, of which 18 papers with one additional paper (M. Reichling) are contained in the present volume. The contributions covered important areas not only of fundamental aspects of Computational Geometry but a lot of interesting and most promising applications: Algorithmic Aspects of Geometry, Arrangements, Nearest-Neighbor-Problems and Abstract Voronoi-Diagrams, Data Structures for Geometric Objects, Geo-Relational Algebra, Geometric Modeling, Clustering and Visualizing Geometric Objects, Finite Element Methods, Triangulating in Parallel, Animation and Ray Tracing, Robotics: Motion Planning, Collision Avoidance, Visibility, Smooth Surfaces, Basic Models of Geometric Computations, Automatizing

Geometric Proofs and Constructions. Fractal geometry has become popular in the last 15 years, its applications can be found in technology, science, or even arts. Fractal methods and formalism are seen today as a general, abstract, but nevertheless practical instrument for the description of nature in a wide sense. But it was Computer Graphics which made possible the increasing popularity of fractals several years ago, and long after their mathematical formulation. The two disciplines are tightly linked. The book contains the scientificcontributions presented in an international workshop in the "Computer Graphics Center" in Darmstadt, Germany. The target of the workshop was to present the wide spectrum of interrelationships and interactions between Fractal Geometry and Computer Graphics. The topics vary from fundamentals and new theoretical results to various applications and systems development. All contributions are original, unpublished papers.The presentations have been discussed in two working groups; the discussion results, together with actual trends and topics of future research, are reported in the last section. The topics of the book are divides into four sections: Fundamentals, Computer Graphics and Optical Simulation, Simulation of Natural Phenomena, Image Processing and Image Analysis. From the reviews: "This book offers a coherent treatment, at the graduate textbook level, of the field that has come to be known in the last decade or so as computational geometry. ... ... The book is well organized and lucidly written; a timely contribution by two founders of the field. It clearly demonstrates that computational geometry in the plane is now a fairly well-understood branch of computer science and mathematics. It also points the way to the solution of the more challenging problems in dimensions higher than two." #Mathematical Reviews#1 "... This remarkable book is a comprehensive and systematic study on research results obtained especially in the last ten years. The very clear presentation concentrates on basic ideas, fundamental combinatorial structures, and crucial algorithmic techniques. The plenty of results is clever organized following these guidelines and within the framework of some detailed case studies. A large number of figures and examples also aid the understanding of the material. Therefore, it can be highly recommended as an early graduate text but it should prove also to be essential to researchers and professionals in applied fields of computer-aided design, computer graphics, and robotics." #Biometrical Journal#2 These proceedings contain papers presented at the 8th Discrete Geometry for Computer Imagery conference, held 17-19, March 1999 at ESIEE, Marne-la- Vall ee. The domains of discrete geometry and computer imagery are closely related. Discrete geometry provides both theoretical and algorithmic models for the p- cessing, analysis and synthesis of images; in return computer imagery, in its variety of applications, constitutes a remarkable experimentational eld and is a source of challenging problems. The number of returning participants, the arrival each year of contributions from new laboratories and new researchers, as well as the quality and originality of the results have contributed to the success of the conference and are an - dication of the dynamism of this eld. The DGCI has become one of the major conferences related to this topic, including participating researchers and la- ratories from all over the world. Of the 41 papers received this year, 24 have been selected for presentation and 7 for poster sessions. In addition to these, four invited speakers have contributed to the conference. The site of Marne-la-Vall ee, just 20 min away from Paris, is particularly we- suited to hold the conference. Indeed, as a newly built city, it showcases a great amount of modern creative architecture, whose pure lines and original shapes o er a favorable context for the topic of Geometry. A basic problem in computer vision is to understand the structure of a real world scene given several images of it. Techniques for solving this problem are taken from projective geometry and photogrammetry. Here, the authors cover the geometric principles and their algebraic representation in terms of camera projection matrices, the fundamental matrix and the trifocal tensor. The theory and methods of computation of these entities are discussed with real examples, as is their use in the reconstruction of scenes from multiple images. The new edition features an extended introduction covering the key ideas in the book (which itself has been updated with additional examples and appendices) and significant new results which have appeared since the first edition. Comprehensive background material is provided, so readers familiar with linear algebra and basic numerical methods can understand the projective geometry and estimation algorithms presented, and implement the algorithms directly from the book. Abstract: "Computer vision is concerned with the development of machines that can process visual information. Computational geometry is concerned with the design of algorithms for solving geometric problems. Most problems in computer vision can be couched in geometric terms. In this paper we outline how computational geometry may significantly contribute to almost every aspect of computer vision and we provide pointers to the computational geometry literature where the most relevant results can be found." This book constitutes the refereed proceedings of the 7th International Workshop on Discrete Geometry for Computer Imagery, DGCI '97, held in Montpellier, France, in December 1997. The volume presents 17 revised full papers together with three invited full papers. The contributions are organized in sections on 2D recognition, discrete shapes and planes, surfaces, topology, features, and from principles to applications. This textbook presents various automatic techniques based on Gr ö bner bases elimination to prove well-known geometrical theorems and formulas. Besides proving theorems, these methods are used to discover new formulas, solve geometric inequalities, and construct objects — which cannot be easily done with a ruler and compass. Each problem is firstly solved by an automatic theorem proving method. Secondly, problems are solved classically — without using computer where possible — so that readers can compare the strengths and weaknesses of both approaches.

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