Generalized Sweep Methods for Parallel Computational Geometry

(Preliminary Version)

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Summary of Results

In this paper we give efficient parallel algorithms for a number of problems from computational geometry by using generalized versions of parallel plane sweeping. We illustrate our approach with a number of applications, which include

- general hidden-surface elimination (even if the overlap relation contains cycles),
- CSG boundary evaluation,
- computing the contour of a collection of rectangles, and
- hidden-surface elimination for rectangles.

Our algorithms are for the CREW PRAM.

1 Introduction

There are a number of algorithms in computational geometry that rely on the "sweeping" paradigm (e.g., see [15, 24, 32]). The generic framework in this paradigm is for one to traverse a collection of geometric objects in some uniform way while maintaining a number of data structures for the objects that belong to a "current" set. For example, the current set of objects could be defined by all those that intersect a given vertical line as it sweeps across the plane, those that intersect a line through a point p as the line rotates around p, or those that intersect a point p as it moves through the plane. The problem is solved by updating and querying the data structures at certain stopping points, which are usually called "events". We are interested in the problem of parallelizing sweeping algorithms.

Most previous approaches to parallelizing sweeping algorithms have been to abandon the sweeping approach all together and solve the problem using a completely different paradigm. Examples include the line-segment intersection methods of Rüb [36] and Goodrich [18], the trapezoidal decomposition algorithm of Atallah, Cole, and Goodrich [4], the method of Aggarwal, Chazelle, Guibas, Ó Dúnlaing, and Yap [2] for constructing Voronoi diagrams, and the method of Chow [11] for computing rectangle intersections. A notable exception, which kept with the plane sweeping approach, were the methods of Atallah, Cole, and Goodrich [4] for 2-set dominance counting, visibility from a point, and computing 3-dimensional maxima points. In each of these algorithms, Atallah *et al.* parallelized sweeping methods that sweep the objects with a vertical line, maintaining the set of objects cut by the line, and computing an associative function (such as "plus" or "min") on the current set of objects for each event.

In this paper we give general methods for parallelizing various types of sweeping algorithms. Specifically, we address problems where the sweep can either be described as a single sequence of data operations or a related collection of operation sequences. The technique does not depend on the sweep being defined by moving a vertical line across the plane, nor any other specific geometric object for that matter. We study cases where the sweep involves moving a point around a planar subdivision and cases where the sweep can be viewed as involving a number of coordinated line sweeps. We motivate our approach by giving efficient parallel algorithms for a number of computational geometry problems. In particular, we derive the following results:

- *Hidden-surface elimination.* One is given a collection of opaque polygons in $\Re^3$ and asked to determine the portion of each polygon that is visible from $(0, 0, +\infty)$ [17, 37, 38]. We show that this problem can be solved in $O(\log n)$ time using $O((n + I)\log^2 n)$ work (i.e., $O((n + I)\log n)$ processors) in the CREW PRAM model, where n is the number of edges and I is the number of edge intersections in the projections of the polygons to the xy-plane.
- *CSG evaluation.* One is given a collection of primitive objects, which are either polygons (in the 2-D case) or polytopes (in the 3-D case), and a tree T such that each leaf of T has an object associated with it and each internal node of T is labeled with a boolean operation (such as union, intersection, exclusive-union, or subtraction) [35, 40, 41]. The problem is to construct a boundary representation for the object described by the root of T. We show

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Proceedings of the Second Annual Symposium on Computational Geometry ,1986 **Proceedings of the Second Annual ACM-SIAM Symposium on Discrete Algorithms** ,1991 This proceedings is designed for computer scientists engineers and mathematicians interested in the use design and analysis of algorithms with special emphasis on questions of efficiency Proceedings of the Annual Symposium on Computational Geometry ,2006 International Conference on Computer Science and Network Security (CSNS 2014) ,2014-06-11 held from April 12 to 13 2014 in Xi an China The purpose of CSNS2014 is to provide a platform for researchers engineers and academicians as well as industrial professionals to present their research results and development on computer science and network security The conference welcomes all the topics around Computer Science and Network Security It provides enormous opportunities for the delegates to exchange new ideas and application experiences to establish global business or research cooperation The proceeding volume of CSNS2014 will be published by DEStech Publications All the accepted papers have been selected according to their originality structure uniqueness and other standards of same importance by a peer review group made up by 2 3 experts The conference program is of great profoundness and diversity composed of keynote speeches oral presentations and poster exhibitions It is sincerely hoped that the conference would not only be regarded as a platform to provide an overview of the general situation in related area but also a sound opportunity for academic communication and connection *Proceedings of the Twenty-Second Annual ACM Symposium on Principles of Distributed Computing* ,2003 This paper presents an efficient asynchronous protocol to compute RSA inverses with respect to a public RSA modulus N whose factorization is secret and shared among a group of parties Given two numbers x and e the protocol computes y such that ye x mod N A synchronous protocol for this task has been presented by Catalano Gennaro and Halevi Eurocrypt 2000 but the standard approach for turning this into an asynchronous protocol would require a Byzantine agreement sub protocol Our protocol adopts their approach but exploits a feature of the problem in order to avoid the use of a Byzantine agreement primitive Hence it leads to efficient asynchronous protocols for threshold signatures and for Byzantine agreement based on the strong RSA assumption without the use of random oracles Proceedings of the Twenty-second Annual Symposium on Computational Geometry ,2006 **Three Decades of Progress in Control Sciences** Xiaoming Hu,Ulf Jonsson,Bo Wahlberg,Bijoy Ghosh,2010-10-29 In this edited collection we commemorate the 60th birthday of Prof Christopher Byrnes and the retirement of Prof Anders Lindquist from the Chair of Optimization and Systems Theory at KTH These papers were presented in part at a 2009 workshop in KTH Stockholm honoring the lifetime contributions of Professors Byrnes and Lindquist in various fields of applied mathematics

Survey of Planar and Outerplanar Graphs in Fuzzy and Neutrosophic Graphs Takaaki Fujita,Florentin Smarandache ,2025-01-01 As many readers may know graph theory is a fundamental branch of mathematics that explores networks made up of nodes and edges focusing on their paths structures and properties 196 A planar graph is one that can

be drawn on a plane without any edges intersecting ensuring planarity Outerplanar graphs a subset of planar graphs have all their vertices located on the boundary of the outer face in their planar embedding In recent years outerplanar graphs have been formally defined within the context of fuzzy graphs To capture uncertain parameters and concepts various graphs such as fuzzy neutrosophic Turiyam and plithogenic graphs have been studied In this paper we investigate planar graphs outerplanar graphs apex graphs and others within the frameworks of neutrosophic graphs Turiyam Neutrosophic graphs fuzzy graphs and plithogenic graphs **Recent Perspectives in Pyrolysis Research** Mattia Bartoli,Mauro Giorcelli,2022-04-13 Recent Perspectives in Pyrolysis Research presents and discusses different routes of pyrolytic conversions It contains exhaustive and comprehensive reports and studies of the use of pyrolysis for energy and materials production and waste management Computer Aided Systems Theory - EUROCAST 2009 Roberto Moreno Díaz,Franz Pichler,Alexis Quesada Arencibia,2009-09-30 The concept of CAST as Computer Aided Systems Theory was introduced by F Pichler in the late 1980s to refer to computer theoretical and practical developments as tools for solving problems in system science It was thought of as the third component the other two being CAD and CAM required to complete the path from computer and systems sciences to practical developments in science and engineering Franz Pichler of the University of Linz organized the first CAST workshop in April 1988 which demonstrated the acceptance of the concepts by the scientific and technical community Next the University of Las Palmas de Gran Canaria joined the University of Linz to organize the first international meeting on CAST Las Palmas February 1989 under the name EUROCAST 89 This proved to be a very successful gathering of systems theorists computer scientists and engineers from most European countries North America and Japan It was agreed that EUROCAST international conferences would be organized every two years alternating between Las Palmas de Gran Canaria and a continental European location From 2001 the conference has been held exclusively in Las Palmas Thus successive EUROCAST meetings took place in Krems 1991 Las Palmas 1993 In bruck 1995 Las Palmas 1997 Vienna 1999 Las Palmas 2001 Las Palmas 2003 Las Palmas 2005 and Las Palmas 2007 in addition to an extra European CAST c ference in Ottawa in 1994 **Topological Data Analysis** Nils A. Baas,Gunnar E. Carlsson,Gereon Quick,Markus Szymik,Marius Thaule,2020-06-25 This book gathers the proceedings of the 2018 Abel Symposium which was held in Geiranger Norway on June 4 8 2018 The symposium offered an overview of the emerging field of Topological Data Analysis This volume presents papers on various research directions notably including applications in neuroscience materials science cancer biology and immune response Providing an essential snapshot of the status quo it represents a valuable asset for practitioners and those considering entering the field *Wireless Sensor Networks* Rastko R. Selmic,Vir V. Phoha,Abdul Serwadda,2016-11-02 This book presents a comprehensive overview of wireless sensor networks WSNs with an emphasis on security coverage and localization It offers a structural treatment of WSN building blocks including hardware and protocol architectures and also provides a systems level view of how WSNs operate These building blocks will allow readers to

program specialized applications and conduct research in advanced topics A brief introductory chapter covers common applications and communication protocols for WSNs Next the authors review basic mathematical models such as Voroni diagrams and Delaunay triangulations Sensor principles hardware structure and medium access protocols are examined Security challenges ranging from defense strategies to network robustness are explored along with quality of service measures Finally this book discusses recent developments and future directions in WSN platforms Each chapter concludes with classroom tested exercises that reinforce key concepts This book is suitable for researchers and for practitioners in industry Advanced level students in electrical engineering and computer science will also find the content helpful as a textbook or reference *Encyclopedia of Data Warehousing and Mining, Second Edition* Wang, John,2008-08-31 There are more than one billion documents on the Web with the count continually rising at a pace of over one million new documents per day As information increases the motivation and interest in data warehousing and mining research and practice remains high in organizational interest The Encyclopedia of Data Warehousing and Mining Second Edition offers thorough exposure to the issues of importance in the rapidly changing field of data warehousing and mining This essential reference source informs decision makers problem solvers and data mining specialists in business academia government and other settings with over 300 entries on theories methodologies functionalities and applications *Machine Learning in Production* Andrew Kelleher,Adam Kelleher,2019-02-27 Foundational Hands On Skills for Succeeding with Real Data Science Projects This pragmatic book introduces both machine learning and data science bridging gaps between data scientist and engineer and helping you bring these techniques into production It helps ensure that your efforts actually solve your problem and offers unique coverage of real world optimization in production settings From the Foreword by Paul Dix series editor Machine Learning in Production is a crash course in data science and machine learning for people who need to solve real world problems in production environments Written for technically competent accidental data scientists with more curiosity and ambition than formal training this complete and rigorous introduction stresses practice not theory Building on agile principles Andrew and Adam Kelleher show how to quickly deliver significant value in production resisting overhyped tools and unnecessary complexity Drawing on their extensive experience they help you ask useful questions and then execute production projects from start to finish The authors show just how much information you can glean with straightforward queries aggregations and visualizations and they teach indispensable error analysis methods to avoid costly mistakes They turn to workhorse machine learning techniques such as linear regression classification clustering and Bayesian inference helping you choose the right algorithm for each production problem Their concluding section on hardware infrastructure and distributed systems offers unique and invaluable guidance on optimization in production environments Andrew and Adam always focus on what matters in production solving the problems that offer the highest return on investment using the simplest lowest risk approaches that work Leverage agile principles to maximize development efficiency in production

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Algorithmic Aspects in Information and Management Smita Ghosh,Zhao Zhang,2024-09-18 This two volume set LNCS 15179 15180 constitutes the refereed proceedings of the 18th International Conference on Algorithmic Aspects in Information and Management AAIM 2024 which took place virtually during September 21 23 2024 The 45 full papers presented in these two volumes were carefully reviewed and selected from 76 submissions The papers are organized in the following topical sections Part I Optimization and applications submodularity management and others Part II Graphs and networks quantum and others Spatial Tessellations Atsuyuki Okabe,Barry Boots,Kokichi Sugihara,Sung Nok Chiu,2009-09-25 Spatial data analysis is a fast growing area and Voronoi diagrams provide a means of naturally partitioning space into subregions to facilitate spatial data manipulation modelling of spatial structures pattern recognition and locational optimization With such versatility the Voronoi diagram and its relative the Delaunay triangulation provide valuable tools for the analysis of spatial data This is a rapidly growing research area and in this fully updated second edition the authors provide an up to date and comprehensive unification of all the previous literature on the subject of Voronoi diagrams

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