Discrete Comput Geom 2:97-98 (1987)

Discrete & Computational Geometry

Guest Editor's Introduction

The first five articles appearing in this special issue are revised and expanded versions of papers that were presented at the ACM SIGGRAPH/SIGACT Symposium on Computational Geometry held June 2-4, 1986, at IBM, Yorktown Heights, New York. They were selected for invitation to the special issue from the 33 papers that were presented at the symposium. These papers had been selected from 100 extended abstracts which were submitted to the conference. The invited articles were chosen for their exceptionally high quality. Emphasis was also placed on choosing papers from the conference which were of great relevance to the goals of this journal and had a component which clearly related to discrete geometry as well as the computational geometry component. The final paper on this issue is included here because of its similarity to those which constitute the special issue.

The first paper, "Triangulating Point Sets in Space" by Avis and ElGindy, considers the problem of triangulating a set of simplicial (i.e., exactly $d+1$ of a set of n points in Euclidean d-space lie on the convex hull) points. They introduce the notion of a "splitter" being a point which partitions a simplex into subsimplices such that a positive fraction of the points avoid each subsimplex. This property provides the possibility that their technique will find application in higher-dimensional divide-and-conquer algorithms which depend upon such a subdivision.

The next two papers, "Linear Space Data Structures for Two Types of Range Search" by Chazelle and Edelsbrunner and "ε-Nets and Simplex Range Queries" by Haussler and Welzl, deal with problems related to range searching. Chazelle and Edelsbrunner consider the problem of building linear space search structures for two specific range-searching problems. They consider the problems of homothetic range searching in the plane and domination range searching in three dimensions. Their first result is optimal in time and space, their second is optimal in space and within a factor of $\log n$ of being optimal in time. Both of their results relate to the problem of finding good partitions of point sets in Euclidian n-space. Haussler and Welzl consider this problem and provide significant improvements over previous results. By relating this problem to the Vapnik-Chervonenkis dimension of a range domain, they are able to produce a structure

they term an ε-net for subdividing a point set. The properties of the ε-net are then used to produce a superior structure for half-space and simplex range queries.

The fourth and fifth papers, "Storing the Subdivision of a Polyhedral Surface" by Mount and "Computing Convolutions by Reciprocal Search" by Guibas and Seidel, are related in that each deals with data structuring issues involved in storing subdivisions of 2-manifolds. Mount extends the method of planar subdivision searching to algorithms for searching a subdivision which occurs on the surface of a polyhedron. He considers a polyhedron to be determined by the edges connecting adjacent faces and the geodesics connecting edges of a common face. This then provides a "grid-like" structure which must be represented in order to provide for efficient searching. Guibas and Seidel consider the problem of efficiently determining the relation between two sets of objects in the plane. A general case of the problem they consider is to determine the interrelationships between two planar subdivisions. A technically difficult issue arises in their discussion since the output size for their problems may vary between 0 and quadratic in the size of the input. They handle this delicate issue by provide algorithms with running times which depend upon the size of the output in the given situation rather than a worst case output.

The final paper in this issue, "New Applications of Random Sampling to Computational Geometry" by Clarkson, is in the spirit of the other contributions. Clarkson describes methods based upon random sampling which yield data structures with construction times which are efficient on the average. This technique is based upon probabilistic arguments not unlike those used by Haussler and Welzl and generates results for problems in the spirit of that paper and the one by Chazelle and Edelsbrunner which are included here.

The preparation of this issue could only have proceeded with the cooperation of the program committee for the original conference, the compliance of the authors to deadlines which were often severe, and the aid of referees. To all of them, warm thanks are gratefully given.

David Dobkin
Guest Editor