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Guest Editors' Foreword

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This special issue contains a selection of six papers that appeared in preliminary form at the Twenty-Second Annual Symposium on Computational Geometry, June 5–7, 2006, in Sedona, Arizona, USA. The program committee for the symposium, which we co-chaired, selected for presentation 54 papers from among 138 submissions. The six papers of this special issue were selected from among the 54 papers for their outstanding contributions to the research topics prominent in the journal Discrete & Computational Geometry.

Crossing numbers of graphs play an important role in discrete geometry, and some beautiful proofs in the area rely on them. This special issue contains two papers discussing crossing numbers.

First, Ackerman makes progress on an old conjecture that states that if a topological graph on n vertices has no k pairwise crossing edges, then it has at most $C_k \cdot n$ edges. The conjecture follows from Euler's formula for $k = 2$ and was known to hold for $k = 3$. Ackerman extends this to the case $k = 4$ with $C_4 \leq 72$.

In a second paper on crossing numbers, Pach and Toth discuss the implications of changing the definition of the crossing number to count multiple crossings in the same point only once. Perhaps surprisingly, they show that any graph with e edges can be drawn using at most e such (multiple) crossings. This contrasts sharply with the lower bound of $\Omega(e^3/n^2)$ on the classic crossing number. However, if one considers simple drawings of graphs only, where any two edges are allowed to intersect at most once, then they can show a lower bound of $\Omega(e^4/n^4)$ multiple crossings.

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Arrangements of surfaces are another classic research topic in discrete and computational geometry. The minimization diagram or lower envelope of an arrangement plays a role in various areas of computational geometry, for instance, in the study of Voronoi Diagrams. It was known that in dimension at most three, the *overlay* of two minimization diagrams is asymptotically of the same complexity as a single diagram. Koltun and Sharir give the first nontrivial bounds on the complexity of the overlay of two or more minimization diagrams in four and higher dimensions, as well as a construction algorithm and applications.

Yet another classic topic in computational geometry is range searching, with a long history of results on exact and approximate search structures. Arya, Malamatos, and Mount study the influence on the computational complexity of approximate range searching of the type of range (smooth shapes versus shapes with sharp corners) and the type of query (idempotent as in emptiness queries, integral as in counting queries). They give nearly tight bounds showing that idempotence helps for smooth ranges but does not help for ranges with corners.

A few years ago, it was shown that any simple polygon can be "morphed" to any compatible simple polygon (that is, a polygon with the same number of edges) without self-intersections. Iben, O'Brien, and Demaine describe an algorithm that generates such an interpolation sequence. The algorithm is flexible in that it can work with any distance metric on the space of polygons and can incorporate additional algebraic constraints on the intermediate polygons.

The final paper in this special issue is from the very active research area of surface reconstruction. Surface reconstruction algorithms with theoretical guarantees on the quality of the reconstruction make use of the local feature size, the distance between a surface point and its medial axis. Chazal, Cohen-Steiner, and Lieutier introduce a parameterized notion of feature size and a sampling condition that ensure the topological correctness of a reconstruction for noisy samplings.

We thank the authors for their contributions to the special issue and extend a special thanks to the referees, who provided valuable feedback and suggestions in their thorough reviews. It is our hope that the papers of this issue will be a valuable resource for students and researchers in the field.