Scientific report of Eyal Ackerman

Name:	Eyal Ackerman
Supervisor(s):	Günter Rote, Christian Knauer
Field of Research:	Combinatorial and Computational Geometry
Topics:	rectangular partitions, geometric graph theory, acyclic orientation of drawings
PhD Fellow	at the program from Nov. 2005 to Jan. 2006

Field of Research and Results

My main interest in the past months was in Turán-type problems in geometric graph theory. In such a problem one wishes to bound the number of edges in a geometric (or topological) graph with a given number of vertices that avoids a given geometric pattern. Specifically, I was interested in graphs avoiding k pairwise crossing edges (known as *k-quasi-planar* graphs). In a joint work with Gábor Tardos [3] from Simon Fraser University we found a sharp bound for the maximum number of edges in *simple*[1] 3-quasi-planar graphs. During my stay an FU Berlin, I found a construction for a *non-simple* 3-quasi-planar whose number of edges exceeds this bound. To the best of my knowledge, this is the first Turán-type problem on topological graphs for which one shows that a non-simple graph can have more edges than a simple graph. These results along with other results concerning 4-quasi-planar graphs [1] were submitted to the next *ACM Symposium on Computational Geometry*.

Following a question raised by Michel Pocchiola, I became interested in the following combinatorial problem: Given a set of curves in the plane or a topological graph, find an orientation of the curves or edges which induces an acyclic orientation on the corresponding planar map. In a joint work with Kevin Buchin, Christian Knauer, and Günter Rote [2], we showed connections between the maximum number of crossings per curve or edge, and the hardness of finding a valid orientation.

Recently, I spent some time thinking about the problem of computing the maximum-area rectangle inscribed in a given convex polygon. Discussions on this question together with Günter Rote, Christian Knauer, Kevin Buchin, Frank Hoffmann, and Klaus Kriegel already yield some promising observations and directions for tackling the problem.

[1] In a simple topological graph every pair of edges intersects at most once.

Activities

Talks

- *On the maximum number of edges in k-quasi-planar graphs*
  CGC-Colloquium at the FU Berlin, Nov. 21, 2005
- *On the geometric thickness of bounded-degree graphs*
  Noon Seminar of Theoretical Computer Science at the FU Berlin, Dec. 13, 2005

Other

- Reviewed two journal submissions (for *Algorithmica* and *European Journal of Combinatorics*).
- Attended the Monday lectures and colloquia of the CGC and the Noon Seminar of Theoretical Computer Science at the FU Berlin.

Preview

After returning to Israel I will start writing my dissertation. I hope to graduate by September 2006. I plan to participate in a block course on "embedding of planar graphs" which will take place in TU Berlin at the end of March 2006. Pending on the acceptance of at least one of the papers submitted to the *22nd ACM Symposium on Computational Geometry*, I will take part in this conference which will take place in Arizona at the beginning of June 2006.

References

[1] E. Ackerman, On the maximum number of edges in topological graphs with no four pairwise crossing edges, submitted to *22nd ACM Symp. on Computational Geometry* (**SoCG**).

[2] E. Ackerman, K. Buchin, C. Knauer, and G. Rote, Acyclic orientation of drawings, submitted to *22nd European Workshop on Computational Geometry* (**EWCG**).

[3] E. Ackerman and G. Tardos, The maximum number of edges in quasi-planar graphs, submitted to *22nd ACM Symp. on Computational Geometry* (**SoCG**).