Semester Report SS05 of Dirk Schlatter

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Field of Research:	Random Discrete Structures
Topic:	Planar Graphs
PhD Student	at the program since December 2002

Field of Research

The main part of my research is concerned with the following restricted random graph process: Starting from an empty graph on n vertices, in each step, choose a random edge (of K_n) and insert it into the present graph if it remains planar. The probability of an edge being inserted at a certain stage in this process is of course highly dependent on the previous choices, quite contrary to the situation in the standard random graph model.

The main conjecture was that, as the density evolves, this random planar graph process differs significantly from a uniformly random planar graph of the same (edge) density (see [2] and [1]), but they both share some interesting properties, e.g. they contain a.a.s. all planar subgraphs of constant size.

In a collaboration with Stefanie Gerke, Angelika Steger (both ETH Zürich), and Anusch Taraz (TU München), we can now prove, that already at the early stages of the process, i.e. when the density of the random planar graph process is $1+\epsilon$, a.a.s. it also contains linearly many copies of any fixed planar graph, but is connected (in contrast to the uniform model). We are about to finish a publication concerning these results, and I shall present them in the forthcoming conference "Random Structures & Algorithms".

Afterwards, I would like to investigate another restricted random graph process, the one where triangles are not allowed. Quite contrary to the situation in the planar case, there is strong evidence that not every permissible small graph a.a.s. appears, for example, $K_{5,5}$ and all larger complete bipartite subgraphs seem to be unlikely. However, so far one can only prove [3] that $K_{\log n,\log n}$ a.a.s. does not appear, and any improvement on this result is likely to involve a methodically new approaches.

Activities

Conferences and Workshops

- March 7 – 9 ASZ Learn- and Workshop on *Random Graphs and Probabilistic Methods* at HU Berlin
- June 1 – 4 CGC Spring School on *Enumerative Combinatorics* in Netzeband
- June 6 – 7 IPCO Summer School on *Randomized Methods in Combinatorics and Optimization* at TU Berlin

Lectures and Seminars

- Weekly seminars of the Institute of Theoretical Computer Science at ETH Zürich (until March 31)
- Weekly seminars of the research group *Algorithms and complexity* at HU Berlin (from April 1)
- Weekly lecture and colloquium of the CGC (from April 18)
- Weekly lectures and tutorial on *Planar Graphs* (SS 05 HU Berlin, with M. Schacht)

Research stay

- October 7 – March 31 long-term stay at ETH Zürich
- June 14 – 17 with Anusch Taraz at TU München
- June 27 – 30 with Anusch Taraz at TU München

Preview

I will finish the work on the random planar graph process and possible generalizations, and will then consider another type of restricted random graph process, as described above. I plan to visit the RSA conference (August 1 – 5 in Poznan), the Eurocomb conference (September 5 – 9 at TU Berlin), the

CGC Annual Workshop (September 25 – 28 on Hiddensee), and the block course *Combinatorial Optimization at work* (October 4 – 15 at TU Berlin).

References

[1] S. Gerke, C. McDiarmid, A. Steger, and A. Weißl, *Random planar graphs with n nodes and a fixed number of edges*, Proceedings of the 16th ACM-SIAM Symposium on Discrete Algorithms (SODA'05), 999-1007, 2005.

[2] C. McDiarmid, A. Steger, and D.J.A. Welsh, *Random planar graphs*, Journal of Combinatorial Theory, Series B 93,187-205, 2005.

[3] D. Osthus and A. Taraz, *Random maximal H-free graphs*, Random Structures and Algorithms 18, 61-82, 2001.