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Special Issue on Selected Papers from the Seventeenth International Symposium on Graph Drawing, GD 2009: Guest Editors' Foreword

David Eppstein [1] *Emden R. Gansner* [2]

[1] Computer Science Department
University of California, Irvine
[2] Information Visualization Research
AT&T Labs - Research

E-mail addresses: eppstein@uci.edu (David Eppstein) erg@research.att.com (Emden R. Gansner)

This special issue focuses on the *Seventeenth International Symposium on Graph Drawing*, which was held at Chicago, USA during September 2009. We invited the authors of the papers that the program committee rated most highly to submit extended versions of their work. The submitted papers have all undergone a thorough refereeing process, leading to the final revisions that we present here.

As is typical with the Symposium, the papers cover a variety of theoretical aspects of graph drawing, as well providing a mathematical analysis of some practical aspects of drawing real-world graphs.

To start, Duncan et al. reconsider the problem of embedding higher-genus graphs in the plane. They consider three natural aesthetic criteria for such drawings: line segments used for edges, a convex polygon for a boundary, and polynomial area. For toroidal graphs, they present an algorithm which attains all three criteria. For graphs of higher genus, they present three algorithms, each able to achieve all of but one of the criteria. It speaks to the vitality of the field that their work was extended in a paper at the 2010 Symposium.

In his paper, Schulz starts from Steinitz' fundamental result equating planar 3-connected graphs and 3-polytopes, and asks how to construct a "nice" 3-polytope for a given graph, one in which the vertices are all a minimum distance apart, yet the polytope has small volume. Combining equilibrium stress with additional constraints, he is able to create a polytope for a graph with n vertices that fits in a $2(n-2) \times 2 \times 1$ box.

Two areas of graph drawing that have recently received a great deal of attention are right angle crossing (RAC) drawings and simultaneous embeddings. We are fortunate to have a representative of each. The idea behind RAC drawings is that, for a graph that cannot be drawn without edge crossings, the crossings should be drawn with as large an angle as possible. In our third paper, Angelini et al. present us with both negative and positive results. They find that there are planar directed acyclic graphs for which there is no straight-line upward RAC drawing, that determining whether such a drawing exists is NP-hard, and that even when a drawing exists it may require exponential area. On the plus side, they show that if one sufficiently restricts the maximum degree of a graph, one can achieve a RAC drawing with at most one or two bends per edge, and quadratic area.

The question of geometric simultaneous embeddings asks whether two planar graphs that share the same vertex set can both have a straight-line plane drawing using the same vertex embedding. As with RAC drawings, this is a knotty area and we often must be content with both good and bad news. The authors of our fourth paper, Cabello et al., consider the case where one of the graphs consists of an independent set of edges, or a matching. They show that this is not a strong enough restriction to guarantee a simultaneous embedding: there exists a planar graph and a matching that cannot be simultaneously embedded. However, any wheel, outerpath or tree does admit a geometric simultaneous embedding with any matching, using at most two orientations for the edges.

Canonical orderings, and the related Schnyder woods, are one of the most important tools in working with planar graphs, both in theory and in practice.

In theory, there are quick algorithms for constructing a canonical ordering, but in practice, these can be difficult to get right. Badent et al. address this problem, and describe a simple, intuitive algorithm. In passing, they also show how a Schnyder wood corresponds to an equivalence class of canonical orderings.

The principal technique for drawing directed acyclic graphs is Sugiyama's algorithm, which separates the tasks of level assignment and crossing reduction. Chimani et al. consider what would happen if these tasks were combined into a single process that determines levels with an eye toward reducing crossings. In their paper, they present an algorithm for this combined task based on upward planarization, and they show that, with a modest increase in the number of levels, one can achieve a significant decrease in edge crossings.

Finally, Brandes and Pich look at the topic of radial layouts, a style of graph drawing heavily used for social networks. They put aside the piecemeal techniques previously used, and show how to address the problem of radial constraints using a variably weighted stress scheme. In addition to its simplicity and flexibility, this approach promises to allow the addition of radial constraints to an initial graph drawing while preserving the structure as much as possible.

We close by acknowledging our debt to the authors of this volume, for taking the effort to extend their papers and submit them; to the many reviewers who contributed their time to a largely unrewarded task; and the Editors of the Journal of Graph Algorithms and Applications for making this special issue possible.