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Advances in Graph Drawing

Special Issue on Selected Papers from the Ninth International Symposium on Graph Drawing, GD 2001

Guest Editors' Foreword

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This Special Issue brings together selected papers from the Ninth Annual Symposium on Graph Drawing, held in Vienna, Austria, on September 23–26, 2001. We have invited the strongest papers in the ranking generated by the GD program committee and we are glad that the following five papers could be included into this special issue after a strong refereeing process.

All papers in the issue deal with planar graphs and trees, respectively, and their crossing free representation. Planar graph drawing is getting increasing attention with the availability of software libraries such as AGD, PIGALE, and GDToolkit that have implemented the planarization approach and a variety of planar graph drawing algorithms.

Classical algorithms for angular resolution are all based on unit vertex and unit bend separation in the Cartesian coordinate representation. The paper by C. A. Duncan and S. G. Kobourov suggests to use a polar coordinate representation for drawing planar graphs, thus allowing independent control over the vertex resolution, bend-point resolution, and edge separation. The authors also provide a family of algorithms demonstrating the strength of the polar coordinate representation in comparison to the standard (Cartesian) representation.

Bend minimization is an important topic in planar graph drawing and even more in planar orthogonal graph drawing. So far there is no characterization for those planar graphs with maximum degree four that can be drawn orthogonally without any bends at all. The paper by Md. S. Rahman, T. Nishizeki, and M. Naznin provides a necessary and sufficient condition for a plane graph, i.e., a planar graph with given planar embedding, of degree at most three to have an orthogonal drawing without bends. The authors also provide a linear time algorithm for constructing such a drawing if it exists.

Drawings without bend points in an alternative setting are considered in the paper by S. Felsner, G. Liotta, and S. Wismath. They investigate the question which graphs can be drawn straight-line and crossing free on a strip, i.e., a grid of size $n \times k$. They give a characterization for trees satisfying this condition and prove lower bounds for the height k for arbitrary planar graphs. Moreover, they show that every outerplanar graph can be drawn crossing-free with straight lines in linear volume on a 3-dimensional restricted grid called *prism*. This is not true for general planar graphs, not even if the prism is extended to a so-called *box*, i.e., an integer grid of size $n \times 2 \times 2$.

The paper by R. Babilon, J. Matoušek, J. Maxová, and P. Valtr deals with the problem of low-distortion embeddings of trees. They show that every tree on n vertices with edges of unit length can be embedded in the plane with distortion $O(\sqrt{n})$, i.e., the distance between each pair $u, v \in V$ of vertices in the embedding correlates with the length of the path from u to v in the tree distorted by a factor up to $O(\sqrt{n})$. This embedding can be found by a simple formula. This result is best possible in the sense that it is asymptotically optimal in the worst case.

Finally, the paper by H. de Fraysseix and P. Ossona de Mendez investigates minimal non-planar structures of non-planar graphs in a depth-first-search setting. Kuratowski characterized the minimal forbidden substructures in a planar graph, namely the subdivisions of K_5 and $K_{3,3}$. In quite some applications in graph drawing it is essential to find either one or many of these Kuratowski subdivisions. The authors provide a characterization of so-called *DFS cotree-critical graphs* and give a simple algorithm for finding one ore more Kuratowski subdivisions which is useful for the planarity testing and planarization algorithms based on depth-first-search.

We would like to thank the JGAA editors for inviting us to compile this special issue, the referees for their invaluable help, and all authors for the considerable extra effort they put into making their GD 2001 contributions into the journal articles contained in this issue.