Guest Editors’ Foreword

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Special Issue of Selected Papers from the 30th International Symposium on Graph Drawing and Network Visualization (GD 2022) Guest Editors' Foreword

Patrizio Angelini[1] *Reinhard von Hanxleden*[2]

[1]Department of Mathematics, Natural, and Applied Sciences
John Cabot University, Rome, Italy
[2]Department of Computer Science
Kiel University, Kiel, Germany

E-mail addresses: pangelini@johncabot.edu (Patrizio Angelini) rvh@informatik.uni-kiel.de (Reinhard von Hanxleden)

1 Introduction

This special issue of the Journal of Graph Algorithms and Applications is dedicated to some of the best papers from the 30th International Symposium on Graph Drawing and Network Visualization.

Following the hybrid GD Symposium in 2021 (hosted by the University of Tübingen, Germany), the 2022 event was held again in hybrid form and hosted by the Tokyo Institute of Technology, Tokyo, Japan, on September 13–16, 2022. The local organizing committee was chaired by Prof. Takayuki Itoh, from Ochanomizu University, Japan.

The authors of five of the best papers presented at the symposium were invited to submit a revised and extended version of their work to this special issue. The submitted papers went through the standard thorough reviewing process of the journal and all of them were eventually accepted after further revisions. They span a broad range of topics of interest for the Graph Drawing and Network Visualization community, covering both experimental and theoretical aspects of the research field.

The papers appear here in alphabetical order of the last names of the first authors. We briefly introduce all papers.

- An *st*-orientation of a graph is an assignment of edge directions so that the resulting digraph contains no directed cycle and has a single source s and a single sink t. The study of *st*-orientations has a long tradition in graph theory, and a preliminary step in several graph drawing algorithms consists of computing an *st*-orientation, possibly with some application-specific properties. In some of these applications, the presence of many transitive edges turns out to be detrimental for the final outcome of the algorithm. In *st-Orientations with Few Transitive Edges*, Carla Binucci, Walter Didimo and Maurizio Patrignani study the problem of computing *st*-orientations with the minimum number of transitive edges. They prove that the problem is NP-hard in general and provide an ILP (Integer Linear Programming) model for planar graphs. By means of an experimental evaluation, they show that their heuristic approach is fast in practice and significantly reduces the number of transitive edges with respect to unconstrained *st*-orientations computed via classical *st*-numbering algorithms.

- In modern applications, it is often necessary to visualize graphs that evolve over time. In a graph story, vertices enter a graph one at a time and each vertex persists for a fixed amount of time ω, called viewing window. At any time, the user can see only a drawing of the graph induced by the vertices in the viewing window. It is required that vertices and edges maintain the same representation in all the drawings they belong to. In *Small Point-Sets Supporting Graph Stories*, Giuseppe Di Battista, Walter Didimo, Luca Grilli, Fabrizio Grosso, Giacomo Ortali, Maurizio Patrignani, and Alessandra Tappini study the problem of computing the whole sequence of drawings by mapping the vertices to only $\omega + k$ given points, where k is as small as possible. They show that: (i) The problem does not depend on the specific set of points but only on its size; (ii) the problem is NP-hard (even when k is a given constant) and it is FPT when parameterized by $\omega + k$; (iii) for $k = 0$, there are families of graph stories that can be drawn for any ω, but also families that cannot be drawn even when ω is small; (iv) there are families of graph stories that cannot be drawn for any fixed k and families of graph stories that can be realized only when k is larger than a certain threshold.

- A graph is rectilinear planar if it admits a planar orthogonal drawing without bends. Testing whether a given graph is rectilinear planar is NP-hard in general, and it is a long-standing open problem to establish a tight bound on the complexity of the recognition problem for partial 2-trees, i.e., graphs whose biconnected components are series-parallel. In *Rectilinear Planarity of Partial 2-Trees*, Walter Didimo, Michael Kaufmann, Giuseppe Liotta, and Giacomo Ortali provide an $O(n^2)$-time algorithm for this problem, which significantly improves over the previous best bound of $O(n^3 \log n)$. Moreover, for partial 2-trees where no two parallel-components in a biconnected component share a pole, they are able to achieve optimal $O(n)$-time complexity.

- In a simple drawing of a graph in the plane, vertices are distinct points, edges are Jordan arcs connecting their endpoints, and edges intersect at most once (either in a proper crossing or in a shared endpoint). It has been conjectured that any simple drawing of the complete graph K_n on n vertices contains at least $2n - 4$ empty triangles. In *Empty Triangles in Generalized Twisted Drawings of K_n*, Alfredo Garcia, Javier Tejel, Birgit Vogtenhuber, and Alexandra Weinberger prove this conjecture in the positive for generalized twisted drawings, the subclass of simple drawings in which there is a point O such that every ray emanating from O crosses every edge of the drawing at most once, and there is a ray emanating from O that crosses every edge exactly once.

- A Feedback Arc Set (FAS) of a directed graph is a set of edges whose removal leaves the digraph acyclic. Computing a FAS with minimum size is an important problem with several applications in graph drawing and, more in general, in graph theory. In particular, it constitutes the first step of both known frameworks for hierarchical graph drawing of directed graphs. The problem is known to be NP-hard, but several heuristic approaches have been proposed. In *Effective Computation of a Feedback Arc Set Using PageRank*, Vasileios Geladaris, Panagiotis Lionakis, and Ioannis Tollis present a new heuristic algorithm for computing a minimum FAS in directed graphs, based on the popular PageRank algorithm for web-graphs. They experimentally show that this new technique produces solutions that, for graph drawing datasets, are better than the ones produced by other popular heuristics, often reducing the FAS size by more than 50%.

We are grateful to the authors for revising and extending their original GD'22 papers and for producing such high-quality contributions, to the referees for their valuable and thorough comments, and to the staff of the Journal of Graph Algorithms and Applications who made this special issue possible.