



Special Issue of Selected Papers from the 31th International Symposium on Graph Drawing and Network Visualization (GD 2023) Guest Editors' Foreword

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1 Introduction

This special issue of the Journal of Graph Algorithms and Applications is dedicated to some of the best papers from the 31th International Symposium on Graph Drawing and Network Visualization.

Following the two hybrid GD symposia in 2021 (Tübingen, Germany) and 2022 (Tokyo, Japan), finally a traditional fully in-person conference could again take place on September 20–22, 2023, in Isola delle Femmine (Palermo), Italy. The local organizing committee was chaired by Emilio Di Giacomo, Fabrizio Montecchiani, and Alessandra Tappini, from the University of Perugia, Italy.

The authors of six 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 theoretical and experimental 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. Marked citations are from the original conference reviews.

Min- k -planar Drawings of Graphs by *C. Binucci, A. BünGENER, G. Di Battista, W. Didimo, V. Dujmović, S.-H. Hong, M. Kaufmann, G. Liotta, P. Morin, A. Tappini*.

We are presented with a new beyond-planarity concept that asks for a drawing where, for any pair of crossing edges, at least one of the edges may be involved in at most k edges. The authors discuss upper bounds on the density of such graphs, in particular for the cases $k = 1, 2, 3$, and the interplay between this concept and the related notion of k -planarity,

The work “presents a nice extension of planar graphs” which the reviewers felt would “likely create some interesting discussions among attendees interested in the beyond-planarity type problems.” The proofs are considered “not trivial”; indeed one reviewer even mentioned that it is “really surprising that [the results] have so complicated proofs”.

Fixed-Parameter Algorithms for Computing RAC Drawings of Graphs by *C. Brand, R. Ganian, S. Röder, F. Schager*.

In right-angle-crossing (RAC) drawings, edges may have (typically a restricted number of) bends, but any two edges that cross must do so at a 90 degree angle. While several graph theoretic

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results to the problem are known, the authors for the first time combine RAC drawings with the algorithmic question for fixed-parameter tractability. They give kernelization algorithms when parameterized by the graph’s feedback edge number or the combined parameter of the vertex cover number and the overall number of bends.

The reviewers found “the paper interesting, as there is no previous results in the literature about parameterized complexity of RAC drawings”. The reduction algorithms have “nice ingredients”, are “non-trivial” and “not really obvious”. Multiple reviewers independently commented that “the open problems are very interesting and propose some directions for future studies” for “people in the intersection of graph drawing and parameterized complexity ([a] community that is now rather growing)”.

On the Biplanarity of Blowups *by D. Eppstein.*

A 2-blowup of a graph replaces each vertex by two independent copies. Gethner conjectured that the 2-blowup of a planar graph is biplanar, i.e., the union of two planar graphs, which is disproved in this paper by showing that so-called iterated Kleetopes are in violation. Starting from this, the relationship between blowups and split thickness is further analyzed.

The contribution won the best paper award in Track 1 of GD 2023 as its “results advance [the] state of knowledge concerning biplanarity and related concepts”. It was deemed “very detailed, clearly explained and well motivated[, ...] a pleasure to read”. As one reviewer aptly put it in a remark to the PC “Thanks for the opportunity to read such a well-written and interesting article.”

Computing Hive Plots: A Combinatorial Framework *by M. Nöllenburg, M. Wallinger.*

As the only Track 2 paper in this special issue, the paper presents a practical implementation for the so-called Hive Plot drawing style. Thereby, vertices are placed on radial axes emanating from a common center, with edges being routed as smooth curves. The authors take care to structure the algorithmic approach into distinct combinatorial optimization subtasks which are then subsequently solved by specifically constructed heuristics and exact algorithms. The paper presents an experimental study on the algorithmic choices and makes the code freely available.

The reviewers found Hive Plots a “compelling approach to the visualization of graphs” and it was felt that the “paper makes an interesting contribution, both from a combinatorial and a visualization point of view”. “The framework is well-designed and the problems arising from the three steps have been thoughtfully addressed” while “the case study highlights interesting behaviors”.

Removing Popular Faces in Curve Arrangements *by P. de Nooijer, S. Terzidis, A. Weinberger, Z. Masárová, T. Mchedlidze, M. Löffler, G. Rote.*

A (classic) nonogram is a popular pen-and-paper puzzle where one has to color grid cells black or white – often resulting in a picture in the end – in accordance to some clues on the stretches of colored cells per row and column. In a curved nonogram, one has arbitrary curves instead of straight grid lines. There, a certain type of face, called popular, makes the puzzle much harder. The authors discuss the NP-hard problem of adding a single further curve to eliminate all popular faces (as would be necessary in the automatic generation of such puzzles) and give a randomized FPT algorithm, parametrized by the number of popular faces.

The paper is topic-wise certainly atypical compared to most GD submissions, but the core of the paper is the “arrangements of curves and their algorithmic manipulation” which “was always part of graph drawing”. Indeed, the consensus was that “the results are very interesting”, the “presentation of the article is very good”, and reviewers “enjoyed reading it”.

On RAC Drawings of Graphs with Two Bends per Edge *by C. D. Toth.*

The second paper considering RAC drawings considers the maximum possible number of edges, if each edge may have at most two bends. Improving over the twelve year old result of $74.2n$, the author himself improved the originally conference-submitted $24n - 26$ further down to $20n - 24$, as is now shown in this journal version of the result.

The reviewers acknowledged that the (short!) paper makes a “significant improvement” on a “long standing open question in beyond-planarity research”, and thus “perfectly matches the scope of GD”. Furthermore, the referees felt that the proof is “very creative” and they were “enjoyed learning about the new proof methods”.

We are grateful to the authors for revising and extending their original GD 2023 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.