Dear colleagues, welcome to Průhonice.

We are happy to host GD in the Czech Republic again after 20 years. We hope that you will enjoy the meeting, its scientific content, as well as the beauty and rich culture of our city and country.

In this booklet you will find details about the conference programme and a few notes on local matters.

We are grateful for generous support from traditional sponsors Tom Sawyer Software, yWorks, Springer, and from the local sponsors AVAST, Unicorn, RSJ and Znovín. With their help we could offer travel grants for young women researchers and students and also directly support of the conference. We thank the School of Computer Science of the Faculty of Mathematics and Physics of the Charles University, and Institute of Mathematics of the Academy of Sciences of the Czech Republic for their logistic and organizational support.

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Jiří Fiala, OC co-chair
Pavel Valtr, OC co-chair
Martin Balko
Anna Kotěšovcová, CONFORG

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Abstracts of invited lectures

John T. Stasko: Pushing the Boundaries of Interaction in Data Visualization

People use data visualization for two main purposes, communication and analysis. On the analysis side, when the data being examined is of modest size or larger, it is difficult to imagine an effective visualization system without interaction. In this talk, I'll outline the value and uses of interaction for visualization, focusing on recent challenges and opportunities that have arisen. For example, what are good ways to interact with a visualization on a small screen without a mouse and keyboard present? And how can multimodal input, including speech and touch, assist people's interactions with visualizations? To answer these questions, I'll show examples of recent visualization projects, with a specific emphasis on graph and network visualizations.

Bartosz Walczak: Old and New Challenges in Coloring Graphs with Geometric Representations

A central problem in graph theory is to compute or estimate the *chromatic number* of a graph, i.e., the minimum number of colors to be put on the vertices so that no two neighbors receive the same color. Being very hard in general, it has been considered for various restricted classes of graphs, in which the chromatic number remains in a tighter connection to the structure of the graph. This includes, in particular, classes of graphs defined on families of geometric objects: intersection graphs, disjointness graphs, visibility graphs, etc., motivated by practical applications in resource allocation, map labeling, and VLSI design. This area of research has seen remarkable progress in recent years. In particular, we have already quite a good understanding of which classes of graphs (with geometric representations) allow the chromatic number to be bounded by a function of the maximum size of a clique and which do not. Much less is known about the growth of these bounding functions, for instance, whether the chromatic number can be bounded by a *polynomial* of the size of the maximum clique.

The goal of this talk is to familiarize the audience with classical and new problems in coloring graphs with geometric representations, and to present some of the most recent developments, including a quadratic bound on the chromatic number in terms of the maximum clique size for circle graphs (intersection graphs of chords of a circle), due to Davies and McCarty.

Guiseppe Di Battista: This Is Time in/for Graph Drawing

In all fields of science and technology graph-inspired models are used to represent and understand reality, and the effectiveness of such models is often related to their graphical representation. this motivates the birth and the development of graph drawing as a self-standing scientific discipline.

During its evolution, lasting about half a century, graph drawing successfully faced several challenges, in some cases originated by the requirements of the reality to be represented and in some cases motivated by deep theoretical questions. this happened at the meeting point of the fields whose combination is the core of graph drawing, namely, algorithmics, computational geometry, graph theory and combinatorics, and information visualization (in alphabetical order).

One of the main challenges for Graph Drawing is the relationship between drawings and time (i.e., the temporal evolution of the visualized graphs). This relationship has been the subject of studies throughout the entire history of the discipline, as it is witnessed by the presence of about 40 papers on this topic in the Graph Drawing Conference Proceedings. On the other hand, this challenge inspired an even larger body of literature in the Information Visualization field. For several reasons, this literature has grown in a way that is largely independent from the Graph Drawing one.

We will discuss the main methods and techniques that the Graph Drawing community devised to deal with time, emphasizing their algorithmic, combinatorial, and geometric aspects, and considering their practical applicability to Information Visualization. We will focus on dynamic algorithms, streaming, animation, and morphing.

Wednesday September 18

9:00 – 9:10	**Opening**	
Session 1	**Cartograms and Intersection Graphs**	
9:10 – 9:30	*S. Chaplick, P. Kindermann, A. Löffler, F. Thiele, A. Wolff, A. Zaft and J. Zink:* Stick Graphs with Length Constraints	T1
9:30 – 9:50	*W. Evans, P. Rzążeewski, N. Saeedi, Ch.-S. Shin and A. Wolff:* Representing Graphs and Hypergraphs by Touching Polygons in 3D	T1
9:50 – 10:10	*A. van Goethem, B. Speckmann and K. Verbeek:* Optimal Morphs of Planar Orthogonal Drawings II	T1
10:10 – 10:30	*S. Nickel, M. Sondag, W. Meulemans, M. Chimani, S. Kobourov, J. Peltonen and M. Nöllenburg,:* Computing Stable Demers Cartograms	T2
10:30 – 11:00	coffee break	
Session 2	**Geometric Graph Theory** sponsored by **Unicorn**	
11:00 – 11:20	*S. Chaplick, T. C. Van Dijk, M. Kryven, J.-W. Park, A. Ravsky and A. Wolff:* Bundled Crossings Revisited	T1
11:20 – 11:35	*M. Chimani, P. Kindermann, F. Montecchiani and P. Valtr:* Crossing Numbers of Beyond-Planar Graphs	S
11:35 – 11:55	*O. Aichholzer, R. Fabila-Monroy, A. Fuchs, C. Hidalgo-Toscano, I. Parada, B. Vogtenhuber and F. Javier Zaragoza Martinez:* On the 2-colored Crossing Number	T1
11:55 – 12:15	*O. Aichholzer, M. Balko, M. Hoffmann, J. Kynčl, W. Mulzer, I. Parada, A. Pilz, M. Scheucher, P. Valtr, B. Vogtenhuber and E. Welzl:* Minimal Representations of Order Types by Geometric Graphs	T1
12:15 – 12:30	*L. Castelli Aleardi:* Balanced Schnyder Woods for Planar Triangulations: An Experimental Study with Applications to Graph Drawing and Graph Separators	S
12:30 – 14:00	lunch break	
14:00 – 15:00	**Invited Lecture** *J. T. Stasko:* Pushing the Boundaries of Interaction in Data Visualization	
15:00 – 15:15	**Poster Pitches**	
15:15 – 16:00	**Poster Exhibit**	
15:00 – 15:30	coffee break	
Session 3	**Clustering**	
16:00 – 16:20	*A. Meidiana, S.-H. Hong, P. Eades and D. Keim:* A Quality Metric for Visualization of Clusters in Graphs	T2
16:20 – 16:35	*S.-H. Hong, P. Eades, M. Torkel, Z. Wang, D. Chae, S. Hong, D. Langerenken and H. Chafi:* Multi-Level Graph Drawing Using Infomap Clustering	S
16:35 – 16:55	*H. Förster, R. Ganian, F. Klute and M. Nöllenburg:* On Strict (Outer-) Confluent Graphs	T1
16:55 – 17:05	short break	
Session 4	**Quality Metrics**	
17:05 – 17:25	*M. Borrazzo and F. Frati:* On the Edge-Length Ratio of Planar Graphs	T1
17:25 – 17:45	*F. Chen, L. Piccinini, P. Poncelet and A. Sallaberry:* Node Overlap Removal Algorithms: A Comparative Study	T2
17:45 – 18:00	*O. Aichholzer, M. Korman, Y. Okamoto, I. Parada, D. Perz, A. van Renssen and B. Vogtenhuber:* Graphs with Large Total Angular Resolution	S
18:15 – 19:45	**GD Contest Live Challenge**	

Thursday September 19

Session 5	**Arrangements** sponsored by **RSJ**	
9:00 – 9:20	*O. Firman, P. Kindermann, A. Ravsky, A. Wolff and J. Zink:* Computing Height-Optimal Tangles Faster	T1
9:20 – 9:40	*S. Chaplick, H. Förster, M. Kryven and A. Wolff:* On Arrangements of Orthogonal Circles	T1
9:40 – 10:00	*A. Arroyo, M. Derka and I. Parada:* Extending Simple Drawings	T1
10:00 – 10:15	*J. Pach and I. Tomon:* Coloring Hasse Diagrams and Disjointness Graphs of Curves	S
10:15 – 10:40	coffee break	
Session 6	**A Low Number of Crossings** sponsored by **Tom Sawyer Software**	
10:45 – 11:05	*P. Angelini, M. Bekos, M. Kaufmann and T. Schneck:* Efficient Generation of Different Topological Representations of Graphs Beyond-Planarity	T1
11:05 – 11:20	*P. Angelini, H. Förster, M. Hoffmann, M. Kaufmann, S. Kobourov, G. Liotta and M. Patrignani:* The QuaSEFE Problem	S
11:20 – 11:40	*L. Angori, W. Didimo, F. Montecchiani, D. Pagliuca and A. Tappini:* ChordLink: A New Hybrid Visualization Model	T2
11:40 – 12:00	*S. Devkota, A. Reyan Ahmed, F. De Luca, K. Isaacs and S. Kobourov:* Stress-Plus-X (SPX) Graph Layout	T2
12:00 – 12:10	short break	
12:10 – 12:30	**Best Paper Track 1** *P. Hliněný and A. Sankaran:* Exact Crossing Number Parameterized by Vertex Cover	T1
12:30 – 14:00	lunch break	
14:00 – 15:00	**Invited Lecture** *B. Walczak:* Old and New Challenges in Coloring Graphs with Geometric Representations	
15:00 – 15:30	coffee break	
Session 7	**Morphing and Planarity**	
15:30 – 15:50	*M. Hummel, F. Klute, S. Nickel and M. Nöllenburg:* Maximizing Ink in Partial Edge Drawings of k-Plane Graphs	T1
15:50 – 16:10	*K. Misue and K. Akasaka:* Graph Drawing with Morphing Partial Edges	T2
16:10 – 16:30	*M. Scheucher, H. Schrezenmaier and R. Steiner:* A Note on Universal Point Sets for Planar Graphs	T1
16:30 – 16:40	short break	
Session 8	**Parameterized Complexity**	
16:40 – 17:00	*S. Bhore, R. Ganian, F. Montecchiani and M. Nöllenburg:* Parameterized Algorithms for Book Embedding Problems	T1
17:00 – 17:20	*E. Di Giacomo, G. Liotta and F. Montecchiani:* Sketched Representations and Orthogonal Planarity of Bounded Treewidth Graphs	T1
17:20 – 18:20	**Business Meeting**	
18:30 – 21:00	**Banquet**	

Friday September 20

Session 9	**Collinearities**	
	sponsored by **AVAST**	
9:00 – 9:20	*S. Felsner:* 4-Connected Triangulations on Few Lines	T1
9:20 – 9:35	*T. Biedl, S. Felsner, H. Meijer and A. Wolff:* Line and Plane Cover Numbers Revisited	S
9:35 – 9:55	*P. Kindermann, T. Mchedlidze, T. Schneck and A. Symvonis:* Drawing Planar Graphs with Few Segments on a Polynomial Grid	T1
9:55 – 10:15	*Y. Okamoto, A. Ravsky and A. Wolff:* Variants of the Segment Number of a Graph	T1
10:15 – 10:40	coffee break	
Session 10	**Topological Graph Theory**	
	sponsored by **yWorks**	
10:45 – 11:05	*L. Merker and T. Ueckerdt:* Local and Union Page Numbers	T1
11:05 – 11:20	*P. de Col, F. Klute and M. Nöllenburg:* Mixed Linear Layouts: Complexity, Heuristics, and Experiments	S
11:20 – 11:40	*T. Biedl, E. Wolf Chambers, D. Eppstein, A. de Mesmay and T. Ophelders:* Homotopy Height, Grid-Major Height and Graph-Drawing Height	T1
11:40 – 12:00	*O. Aichholzer, L. Kleist, B. Klemz, F. Schröder and B. Vogthenhuber:* On the Edge-Vertex Ratio of Maximal Thrackles	T1
12:00 – 12:10	short break	
12:10 – 12:30	**Best Paper Track 2**	
	F. De Luca, Md. Iqbal Hossain and S. Kobourov: Symmetry Detection and Classification in Drawings of Graphs	T2
12:30 – 14:00	lunch break	
Session 11	**Level Planarity**	
14:00 – 14:20	*G. Brückner, M. Himmel and I. Rutter:* An SPQR-Tree-Like Embedding Representation for Upward Planarity	T1
14:20 – 14:40	*S. Mallach:* A Natural Quadratic Approach to the Generalized Graph Layering Problem	T2
14:40 – 15:00	*M. Borrazzo, G. Da Lozzo, F. Frati and M. Patrignani:* Graph Stories in Small Area	T1
15:00 – 15:20	*G. Brückner, N. Krisam and T. Mchedlidze:* Level-Planar Drawings with Few Slopes	T1
15:20 – 15:50	coffee break	
15:50 – 16:50	**Invited Lecture**	
	G. Di Battista: This Is Time in/for Graph Drawing	
16:50 – 17:00	**Best Presentation and Best Poster Ceremony & Closing**	

Posters

- *C. Binucci, W. Didimo and F. Montecchiani:* A 1-planarity Testing and Embedding Algorithm
- *T. Mchedlidze, M. Radermacher, I. Rutter and P. Stumpf:* Stretching Two Pseudolines in Planar Straight-Line Drawings
- *P. Lionakis, G. Ortali and I. Tollis:* Adventures in Abstraction: Reachability in Hierarchical Drawings
- *M. Kaufmann and A. Kuckuk:* On Topological Book Embedding for k-plane Graphs
- *H. Förster and M. Kaufmann:* On Compact RAC Drawings
- *G. Liotta, I. Rutter and A. Tappini:* FPQ-choosable Planarity Testing
- *F. De Luca, E. Di Giacomo, S.-H. Hong, S. Kobourov, W. Lenhart, G. Liotta, H. Meijer, A. Tappini and S. Wismath:* Packing Trees into 1-planar Graphs
- *S. Schöttler, T. Kauer and B. Bach:* Geographic Network Visualization Techniques: A Work-in-progress Taxonomy
- *A. Pitchanathan and S. Shannigrahi:* On the Simple Quasi Crossing Number of K_{11}
- *J. Klawitter and P. Stumpf:* Minimising Crossings in a Tree-Based Network
- *N. Saeedi and W. Evans:* Crossing Families and Their Generalizations
- *R. B. Richter and L. Wang:* Which Sets of Strings are Pseudospherical?

Local information

Catering

Lunches and coffee breaks will be served at the conference venue.

Badges

Participants are requested to wear their name badges upon registration during all professional and social activities of GD 2019. Badges will serve as tickets for entrance to the conference and to the social events.

Wi-Fi

Wi-Fi will be provided in all rooms of the conference venue.

Smoking

Smoking inside the conference venue is not allowed. Smoking outside the building is possible.

Taxi

For taxi services, please ask for help at the registration desk. We recommend to use AAA Taxi (`http://www.aaataxi.cz`) or City Taxi (`http://www.citytaxi.cz`).

We strongly advise to ask about the price before the ride, and request a receipt.

Public transport

The nearest bus stop is at Květnové náměstí in front of the conference venue. You need 5 zone ticket for 40 CZK to travel between Průhonice and the nearest subway stop Opatov. Once validated in the bus, the ticket is valid for 2 hours. It is a transfer ticket, so you can use it also in downtown subway, trams and buses. You may get the ticket by the bus driver (automatically validated) or at the vending machines (this one needs to be validated).

Between Průhonice and Opatov you may use two bus lines #363 (peak interval 15 minutes, off peak 30') and #385 (peak 30', off peak 60'). The up to date bus timetable is displayed at each bus stop.

Emergency and Medical Services

Phone Numbers:

150	Fire Fighters
155	Rescue Squad
158	Police of the Czech Republic
156	Prague City Police
112	European Emergency Number

Important Safety Information

In terms of public safety, Prague is similar to other big European cities. Tourists are sometimes targeted by pickpockets and rogue merchants. As we would like you to spend a lovely and unforgettable time in Prague, some recommendations follow:

- Be careful about your handbags and wallets in any public and especially touristic places where a crowd might be present (even if it does not look like it is actually crowded). Be especially careful if you approach a crowd that looks artificially created in a situation where you would not expect a crowd (such as a half-empty underground train or tram or bus car).
- Be alert when someone stands too close to you in public transport, metro escalators or at the stops, or even touches you pretending it is crowded, regardless if it really is or is not.
- Change money only in the bank, official exchange offices or ATMs or use your credit cards for payments. Be careful when using the ATM.

Foreign Exchange and Banking

The official currency in the Czech Republic is Czech Crown (CZK). One can find many exchange offices and banks in Prague, and it is possible to withdraw CZK at ATMs. All major international cards are accepted in shops, hotels and restaurants.

VAT Refund

All foreign visitors to the Czech Republic (except those coming from countries of the European Union) can apply for value added tax (VAT) refund. In order to get the VAT refund the foreigners must fulfill the following conditions:

- The price of the goods including VAT must exceed 2,000 CZK.
- Goods must be purchased on one day from a retailer marked by a TAX REFUND sign.
- The purchased goods must leave the country within 30 days after the day of purchase.
- VAT refund must be claimed 1) with the same retailer in person or 2) through specialized collecting agencies (such as Global Blue, Global Refund, Premier Tax Free).

How to get VAT refund:

1. At the retailer request the VAT REFUND FORM and the receipt. Fill-in the form including the VAT amount, and have it stamped by the retailer.
2. Have your VAT REFUND FORM validated at the border or at the airport by the Czech Customs Office. If you travel by train you must ask for a Customs officer.
3. a) Stop at any of the specialized collecting agency's refund offices at the border and get the cash; or b) return home and mail your VAT forms and receipts to any of the specialized collecting agencies, requesting the refund; or c) keep all the forms and receipts and claim the refund with the same retailer during your next trip to the Czech Republic (within 90 days from the day of purchase).

Tax is not refunded on food, cigarettes, alcohol, and petrol.

Shops and Shopping Centers

Most shops and shopping centers open the whole week from 10 a.m. to 9 p.m. Big shopping centers are closed during state holidays.

Map of the neighborhood

Legend

1. Congress hall
2. Restaurant
3. Hotel
4. Banquet location
5. Castle entrance
6. Bus stops
7. Direction towards the Dendrology garden (approx 1km from Floret)