

Graphics **Interface** 2021

Virtual Event

27–28 May 2021

Proceedings

Edited by

Manolis Savva
Ahmed Sabbir Arif



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ISSN: 0713-5424

ISBN: 978-0-9947868-6-9

Proceedings of Graphics Interface 2021, Manolis Savva and Ahmed Sabbir Arif (Program Chairs), Virtual Event, Canada, 27–28 May 2021.

Published by the Canadian Human-Computer Communications Society / Société canadienne du dialogue humain-machine.

Graphics Interface is sponsored by:

The Canadian Human-Computer Communications Society / Société canadienne du dialogue humain-machine (CHCCS/SCDHM)

Membership Information for CHCCS/SCDHM is available from:

Canadian Information Processing Society (CIPS)

5090 Explorer Drive, Suite 801

Mississauga, Ontario L4W 4T9

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Published by the Canadian Human-Computer Communications Society / Société canadienne du dialogue humain-machine and CRC Press.

Available online through the Association for Computing Machinery (ACM) Digital Library.

Editorial and production support by Meghan Haley at Junction Publishing.

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President's Welcoming Letter



Canadian Human-Computer Communications Society /
canadienne du dialogue humain-machine

Paul G. Kry
School of Computer Science
McGill University, Canada

The Canadian Human-Computer Communications Society (CHCCS) / Société Canadienne du Dialogue Humain Machine (SCDHM) is a non-profit organization dedicated to advancing research and education in computer graphics, visualization, and human-computer interaction. The primary activity of CHCCS/SCDHM is sponsoring the annual Graphics Interface conference, the longest-running regularly scheduled conference on interactive computer graphics.

We are now in a second year of big changes with a different format for the conference. In most years, Graphics Interface has been held as part of a larger suite of conferences: the AI/GI/CRV conference, encompassing Artificial Intelligence and Computer and Robotic Vision along with Graphics Interface. With the approval of the vast majority of the membership at the 2019 CHCCS annual general meeting, the decision to hold an independent conference was seen as an opportunity to reinvigorate Graphics Interface with an inexpensive format that maximizes participation, in particular students. While we forced into a virtual event model for Toronto in 2020 and Simon Fraser University in 2021, we are seeing much higher registration rates due to the ease of virtual participation and the price (free). This year likewise continues with the other big change: open reviewing and multiple paper deadlines. I will be optimistic about the future of Graphics Interface, and the possibility of in person or hybrid models for ETS Montreal in 2022 and Victoria 2023.

New this year is the creation of the early career researcher award. I am very grateful to Alec Jacobson and Audrey Giraud for their efforts in the development of this award. This, and other initiatives in the last year, have come through a renewed focus on strategic planning with meetings throughout the year. The exec and strategy team nominally followed a monthly meeting schedule. One important outcome was the assembly of data on previous program committees to help chairs ensure diversity. Another is that progress has been made in the creation of a nominations committee (initially chaired by Kelly Booth) to ensure there is a clear process for recruiting future chairs and leadership positions. There has been a greater focus on online content following the 2020 conference, with work done to add more videos from previous years to different playlists on the YouTube channel. There has also been an update to the graphicsinterface.org page to feature videos of previous work on the landing page. Finally, important progress has been made with respect to resolving ACM Digital Library problems, DOI migration, and other behind the scenes publishing issues. For their participation and contributions at strategy meetings throughout the year, I thank all the exec, conference chairs, and strategy team members Sara Nabil (Queens), Fateme Rajabiyazdi (Carleton), and Lesley Istead (Waterloo).

I will take a moment to remind everyone that in addition to its annual conference, CHCCS/SCDHM sponsors several awards. The annual Michael A.J. Sweeney Award recognizes best student papers presented at the conference. The annual Alain Fournier Dissertation Award and the Bill Buxton Dissertation Award recognize the best Ph.D. dissertations awarded in Canada during the previous year for computer graphics and human-computer interaction, respectively. The annual CHCCS/SCDHM Achievement Award is presented to a Canadian who has made substantial research contributions to computer graphics, visualization, or human-computer interaction. The CHCCS/SCDHM Service Award is presented to a Canadian who has rendered substantial service contributions to the society or to the research community. Each year the Awards Committee receives nominations and selects a winner of the Achievement Award and, from time to time, a winner of the Service Award. The current committee is chaired by Brian Wyvill (University of Victoria), and has as members Sheelagh Carpendale (University of Calgary), Michiel van de Panne (University of British Columbia), and Carl Gutwin (University of Saskatchewan). I thank the Awards committee for their efforts in selecting very well-deserving recipients. Winners of the Alain Fournier Award and Bill Buxton Award are selected by independent committees coordinated by Pierre Poulin. I am very grateful to Pierre and the members of the respective committees for their work in identifying the top dissertations of 2018. The Michael A.J. Sweeney Award winners are selected by the program co-chairs in consultation with the program committee. Finally, while there will not be an award presented at the conference this year, the CHCCS/SCDHM continues to host the Canadian Digital Media Pioneer awards which were first initiated by the GRAND NCE in 2011, with Eugene Fiume serving to coordinate the selection committee.

The Annual General Meeting of CHCCS/SCDHM is held every year during the Graphics Interface conference, to review the previous year's activities and elect the executive committee. Current members of the executive committee are Paul Kry, McGill University, (president), Pierre Poulin, Université de Montréal, (vice president and treasurer), William Cowan, University of Waterloo, (past president), and Derek Reilly, Dalhousie University (editor-in-chief).

All Graphics Interface attendees are invited to attend the annual general meeting. I encourage everyone interested in the future of Graphics Interface to attend and get involved.

On behalf of the society, and of all those who have worked to put on this year's conference, I extend a warm welcome to all the attendees of GI 2021. I wish to thank this year's chairs, Manolis Savva, Ahmed Arif, and Ali Mahdavi-Amiri, along with the committee members and referees for all their hard work in creating the conference program. Most important, I wish to thank all the authors who submitted their research. Without their commitment there would be no conference.

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Michael A. J. Sweeney Award 2021



Canadian Human-Computer Communications Society /
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The CHCCS/SCDHM honours the memory of Michael A. J. Sweeney through an annual award to the best student papers presented at each year's Graphics Interface conference. The winning papers selected by the program committee, one graphics paper and one HCI paper, are chosen from among accepted papers that have a student as lead author and for which one or more student authors are presenting the paper.

Best Student Papers 2021

In Memory
Michael A. J. Sweeney, 1951-1995

SWIPERING: GESTURE TYPING ON SMARTWATCHES USING A SEGMENTED QWERTY AROUND THE BEZEL

Gulnar Rakhmetulla (Human-Computer Interaction Group, University of California, Merced), Ahmed Sabbir Arif (Human-Computer Interaction Group, University of California, Merced)

CONTOUR LINE STYLIZATION TO VISUALIZE MULTIVARIATE INFORMATION

Gazi Md. Hasnat Zahan (Department of Computer Science, University of Saskatchewan), Debajyoti Mondal, Carl Gutwin (Department of Computer Science, University of Saskatchewan)

Alain Fournier Award 2020



Canadian Human-Computer Communications Society /
Société canadienne du dialogue humain-machine

On August 14th, 2000, Dr. Alain Fournier passed away. He was a leading international figure in computer graphics, and a strong and frequent contributor to the Graphics Interface conference. His insights, enthusiasm, wisdom, vast knowledge, humour, and genuine friendship touched everyone he met.

The “Alain Fournier Memorial Fund” was created to celebrate his life, to commemorate his accomplishments, and to honour his memory. It rewards an exceptional computer graphics Ph.D. dissertation defended in a Canadian University over the past year. The winning dissertation is selected through a juried process by a selection committee consisting of accomplished researchers in computer graphics.

For more information about the “Alain Fournier Memorial Fund”, and information about donation, please visit <http://graphicsinterface.org/awards/alain-fournier/>.



Maria (Masha) Shugrina

University of Toronto
CHCCS/SCDHM Alain Fournier
Award Recipient 2020

Maria (Masha) Shugrina is the recipient of the 2020 Alain Fournier PhD Dissertation Award. Her dissertation, entitled “The Design of Playful and Intelligent Creative Tools”, combines artistic insight and artificial intelligence to create new interactive tools for artistic expression.

Digital technology offers an unprecedented ability to craft our own creative media, and machine intelligence holds boundless potential for empowering creativity. This drives Dr. Shugrina’s exploration of design and research to fashion creative tools. Specifically, her thesis makes strong contributions to the representation and exploration of color, as well as provides benchmarks for the evaluation of computer vision techniques, such as feature tracking for artistic applications. She approaches color interfaces from an interaction perspective, inspired by the 2D painting of artists, and from an artificial intelligence perspective derived from hand-drawn animation.

Dr. Shugrina’s passion for enhancing human creativity is solidly anchored in multidisciplinary research. While the primary impact of her PhD contributions are centered on graphics, it has the unique achievement of being published as first author in the top-tier venues of three major domains, including twice at SIGGRAPH (graphics), CVPR (computer vision), and CHI (human computer interaction).

Dr. Shugrina obtained her Bachelor of Arts in Computer Science with a Minor in Mathematics from Boston University in 2007, graduating Summa cum laude, with a College Prize for Excellence in Computer Science. In 2015 she obtained her Masters of Science in Computer Science and Electrical Engineering from MIT working on Methods Enabling Interactive Customization of Fabricable Objects by Non-Professional. She graduated in 2020 with her PhD in Computer Science from the University of Toronto under the supervision of Profs. Karan Singh and Sanja Fidler. During her PhD studies, she was a part-time consultant at NVIDIA Research and Adobe Research.

Bill Buxton Dissertation Award 2020



Canadian Human-Computer Communications Society /
Société canadienne du dialogue humain-machine

The award is named in honour of Bill Buxton, a Canadian pioneer who has done much to promote excellence, both within Canada and internationally, in the field of Human-Computer Interaction. Bill truly advocates HCI. He challenges how academics and practitioners think, and inspires them to do things differently. This is why we are proud to name this award after him.

The award is determined through a juried process by a selection committee consisting of accomplished researchers in Human-Computer Interaction.



Daniel J. Rea

University of Manitoba
CHCCS/SCDHM Bill Buxton Award
Recipient 2020

Photo by Kira Koop.

The recipient of the 2020 award for the best doctoral dissertation completed at a Canadian university in the field of Human-Computer Interaction is Dr. Daniel J. Rea.

Dr. Rea's highly innovative dissertation, *Now You're Teleoperating with Power: learning from video games to improve teleoperation interfaces*, paves the way for an entirely new approach to designing teleoperation interfaces by integrating affective computing and social robotics concepts into the more typical command and control approach. Dr. Rea developed and tested a wide range of prototypes to support remote operation of an industrial robot by systematically considering the psychology of the person operating a robot in order to shape operator experience, improve operation effectiveness, and reduce errors.

The research approach builds on lessons from video game design, which leverages player psychology and affective techniques to shape how people engage and use a game. He applies these techniques to robot teleoperation interfaces and operator control, improving task outcomes without requiring changes or improvements to the robot itself or to its algorithms. He demonstrates the importance of how a robot and its controls are perceived by people, and how interfaces can use social models and techniques to impact the operator and shape interaction, improving outcomes. Novel examples he developed for shaping operator behavior and mental state include directing operator attention, priming operators on robot capabilities (telling them a robot may be dangerous), adding a virtual "nervous" back-seat driver, and modifying joystick feel, robot responsiveness, or robot sound to make a robot seem more (or less) dangerous.

The comprehensive dissertation describes both prototypes that illustrate the new techniques and empirical studies that assess the techniques' effectiveness, and then provides a theory-based summative framework and reflection on the research process that comprises a wonderful example of a complete approach to identifying and solving a problem in HCI.

Daniel Rea earned his BSc, MSc, and PhD degrees in Computer Science from the University of Manitoba. His dissertation supervisor was Dr. James E. Young. The different components of his doctoral research have been published individually in four first-author papers and one second-author paper at top conferences in the field. After a post-doctoral appointment at Kyoto University in Japan, he returned to Canada where he currently holds a faculty position at the University of New Brunswick.

Funding from an anonymous donor established this award in 2011 in honour of Bill Buxton, a Canadian researcher, designer, and musician who has done much to promote excellence in the field of Human-Computer Interaction, both within Canada and internationally. Bill challenges how academics and practitioners think, and he inspires them to do things differently. He is a true advocate for HCI.

The award is determined through a juried process by a selection committee consisting of accomplished researchers in Human-Computer Interaction. This year, the jury was Dr. Christopher Collins (Ontario Tech University), Dr. Regan Mandryk (University of Saskatchewan) who chaired the jury, Dr. Sara Nabil (Queens University), and Dr. Sowmya Somanath (University of Victoria).

Achievement Award 2021



Canadian Human-Computer Communications Society /
Société canadienne du dialogue humain-machine

The CHCCS/SCDHM Achievement Award is presented periodically to a Canadian researcher who has made a substantial contribution to the fields of computer graphics, visualization, or human-computer interaction. Awards are recommended by the CHCCS/SCDHM Awards Committee, based on nominations received from the research community.



Pierre Poulin

Université de Montréal
CHCCS/SCDHM Achievement Award
Recipient 2021

The 2021 CHCCS/SCDHM Achievement Award for computer graphics is presented to Professor Pierre Poulin for his long-term contributions to the field. Dr. Poulin has made lasting and varied contributions to computer graphics over the past thirty years, in areas spanning rendering, modeling, and animation. He has further been a leader in building the graphics research community over this time via research mentorship and sustained organizational efforts in support of computer graphics research in Canada and in Europe.

Dr. Poulin has contributed numerous advances to rendering models and algorithms. His early work on an anisotropic reflection model was a key step in showing that more sophisticated surface reflection models were a necessary and feasible step towards achieving high-quality rendered imagery, to which he later contributed with a number of reflection models. His work on linear light sources, light hierarchies, virtual relighting, and global illumination all helped establish a path to increasingly ambitious efforts in physically-based rendering. He is a co-author of a classical and influential survey of shadow algorithms, and 20 years later of a follow-up book with his friend and collaborator Andrew Woo. Dr. Poulin has further done notable work in animation, including water in its many forms (fluids, waves, waterfalls, droplets), fire and smoke, hair motion, and mocap compression and motif identification. Rounding out his diverse contributions to computer graphics are methods for procedural modeling of buildings and environments, surface weathering, and various systems for image-based modeling and rendering. A continuous theme has been to bring together realism, simulation, efficiency, hierarchies, and user control to benefit creators.

He has served the community in numerous ways, including as CHCCS vice president since 2002, and now treasurer, as well as GRAND team leader. Dr. Poulin co-launched in 2005 and served since then on the Alain Fournier Award for the best Doctoral Dissertation in Computer Graphics, which is funded by donations in honour of his supervisor, Dr. Alain Fournier. He has supervised many in computer graphics, including 19 Ph.D. students, 44 M.Sc. students, and 28 Master students from Europe. He has co-chaired conferences including GI 2000, CGI 2011, Eurographics 2013, and CASA 2014, served on editorial boards of C&G, CGF, and CAVW, and participated on 64 international program committees. He has been a driver of collaborations with multiple computer graphics research labs and colleagues in France, resulting in many bidirectional exchanges.

Dr. Poulin is a Professor with the Département d'informatique et de recherche opérationnelle (DIRO) at the Université de Montréal, where he has been faculty since 1994. He has served as the department Director since 2017, where he has helped hire 11 new faculty members, and guided DIRO through the major expansion of Mila and machine learning, the doubling of the population of most of its computer science programs, the COVID-19 crisis, and plans for a new building. Dr. Poulin earned his B.Sc. at Laval University in 1986, an M.Sc. at the University of Toronto in 1989, and he obtained his Ph.D. from the University of British Columbia. He was a post-doctoral fellow at Princeton with Prof. Pat Hanrahan.

Achievement Award 2021



Canadian Human-Computer Communications Society /
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The CHCCS/SCDHM Achievement Award is presented periodically to a Canadian researcher who has made a substantial contribution to the fields of computer graphics, visualization, or human-computer interaction. Awards are recommended by the CHCCS/SCDHM Awards Committee, based on nominations received from the research community.



Tamara Munzner

University of British Columbia
CHCCS/SCDHM Achievement Award
Recipient 2021

The 2021 CHCCS/SCDHM Achievement Award of the Canadian Human-Computer Communications Society is presented to Dr. Tamara Munzner for her many contributions to the field of visualization. Her work bridges the gap between the HCI and graphics communities.

Tamara is a professor at the University of British Columbia, which she joined in 2002 after two years as a research scientist at the Compaq Systems Research Center. She earned her PhD from Stanford in 2000, working with Pat Hanrahan. She was a technical staff member at the University of Minnesota Geometry Center from 1991 to 1995. She was co-designer of the interactive 3D visualization system Geomview, which directly supported non-Euclidean geometries. She was co-creator of two animations that brought concepts from geometric topology to general audiences: “The Shape of Space” is about spaces that are finite but have no boundaries, and “Outside In” explores turning a sphere inside out. These videos were shown at the SIGGRAPH Electronic Theater, featured on the cover of Scientific American, and won awards at NICOGRAPH, the London Effects and Animation Festival, Prix Pixel Imagina, and Prix Ars Electronica.

Tamara’s research interests include the development, evaluation, and characterization of visualization systems and techniques from both problem-driven and technique-driven perspectives. In problem-driven work, known as design studies, the focus is on designing systems to solve specific needs for a target group of real-world users. Tamara has pioneered the development of design study methodology, reflecting on work within a broad range of application domains, including genomics, evolutionary biology, fisheries management, web log analysis, e-commerce, and journalism. Her technique-driven interests include graph drawing and dimensionality reduction, with an emphasis on scalable algorithms. Her evaluation interests include both controlled experiments in a laboratory setting and qualitative studies in the field. She has contributed substantially to the theoretical foundations of visualization

design and the visualization research process. Her widely used book Visualization Analysis and Design provides a systematic, comprehensive framework for thinking about visualization in terms of principles and design choices. It features a unified approach encompassing information visualization techniques for the abstract data of tables and networks, scientific visualization techniques for spatial data, and visual analytics techniques for interweaving data transformation and analysis with interactive visual exploration.

Tamara has published over 80 papers, including 21 at IEEE InfoVis, and others at many venues including TVCG, VAST, EuroVis, SciVis, SIGGRAPH, CHI, Graphics Interface, PacificVis, Graph Drawing, Information Visualization, and CG&A. Her h-index is 49, her work has amassed over 10,000 citations, and she has given over 200 talks. She has supervised over 40 students and postdocs, who have gone on to positions including Google, Tableau Research, Electronic Arts, AeroInfo, and professorships at Zurich, Northeastern, Stuttgart, Utah, Victoria, and Beuth. She and her group have released over 25 software packages as open source. She has consulted for or collaborated with many companies including Agilent, AT&T Labs, Google, Microsoft, Mobify, Silicon Graphics, Tableau, Uber, and early-stage startups. She serves on the advisory boards for the Data Visualization Society and Data Literacy LLC. She is the co-editor of the AK Peters Visualization Series with CRC Press / Routledge.

Tamara has helped to organize InfoVis in roles ranging from webmaster to inaugural posters chair to papers chair to steering committee chair. She has served as chair of the VIS Executive Committee, chair of the VIS Restructuring Committee (reVise), and a member of the VGTC Executive Committee. She was papers chair for EuroVis and a founding member of the BioVis Steering Committee. She received the IEEE VGTC Visualization Technical Achievement Award in 2015 and is a founding member of the VIS Academy. Her 2009 paper on the nested model of visualization design and validation earned the InfoVis 10-year Test of Time award in 2019.