

Craig S. Kaplan

Curriculum Vitae

David R. Cheriton School of Computer Science
University of Waterloo
200 University Avenue West
Waterloo, Ontario
N2L 3G1 Canada

csk@uwaterloo.ca
www.cs.uwaterloo.ca/~csk/
isohedral.ca
@csk@mathstodon.xyz

Education

PhD, Computer Science & Engineering, University of Washington, 2002.
Dissertation: Computer graphics and geometric ornamental design.

MS, Computer Science & Engineering, University of Washington, 1998.
Thesis: The analysis and generation of Escher-style drawings.

BMath, Double Honours Computer Science & Pure Mathematics CO-OP, University of Waterloo, 1996.

Employment

Professor (2024–present). School of Computer Science, **University of Waterloo**, Waterloo, Ontario.

Associate Professor (2008–2024). School of Computer Science, **University of Waterloo**, Waterloo, Ontario.

Visiting Professor (2013–2014). Department of Computer Science, **University College London**, London, UK.
(Sabbatical)

Assistant Professor (2003–2008). School of Computer Science, **University of Waterloo**, Waterloo, Ontario.

Researcher (1999). Programmer Productivity Research Ctr., **Microsoft Research**, Redmond, Washington.
(Graduate student internship)

Graphics Software Engineer (1994–1997). **Alias|Wavefront**, Toronto, Ontario and Seattle, Washington.
(Four undergraduate internships, one graduate internship)

Software Researcher and Developer (1992–1993). **WATCOM International Limited**, Waterloo, Ontario.
(Two undergraduate internships)

Awards

Marsland Fellowship in Information Technology, 2024–2027.

TIME Magazine “Best Inventions of 2023”, for aperiodic monotile (with David Smith, Joseph Samuel Myers, and Chaim Goodman-Strauss).

CGI’2022 Virtual Reality and Intelligent hardware (VRIH) Best Paper Award, 2022, for “A simple, stroke-based method for gesture drawing” (with Lesley Istead, Joe Istead, and Andreea Pocol).

Journal of Mathematics and the Arts Outstanding Paper Award, 2020, for “Quasiperiodic bobbin lace patterns” (with Veronika Irvine and Therese Biedl).

Outstanding Leonardo Peer Reviewer of the Season from the journal Leonardo, 2019.

Graphics Interface Michael A.J. Sweeney Award for best student paper, 2018, for “RepulsionPak: Deformation-driven Element Packing with Repulsion Forces” (with Reza Adhitya Saputra and Paul Asente).

Graphics Interface Michael A.J. Sweeney Award for best student paper, 2017, for “FLOWPAK: Flow-based Ornamental Element Packing” (with Reza Adhitya Saputra, Paul Asente, and Radomír Měch).

Outstanding Performance Award, 2011

Graphics Interface Michael A.J. Sweeney Award for best student paper, 2006, for “symTone: Two-handed manipulation of tone reproduction curve” (with Ian Bell and Charles L.A. Clarke).

Grand Prize, ACM/IBM Quest for Java, 2000.

Research and scholarship

Areas of interest

Non-photorealistic rendering, particularly the application of mathematical and computational techniques to art, design, and architecture; computer graphics; human-computer interaction; computational geometry; computational tiling theory

Publications

Unless otherwise indicated, author order is from largest to smallest contribution, with a bias towards promoting students to the front of the author list.

Graduate (and, rarely, undergraduate) student co-authors are indicated by (*); postdoctoral researchers are indicated by (**). If a paper is marked with (***), then I am not sure which authors are students or postdocs.

Articles in preparation

- [1] Greg Philbrick(*) and Craig S. Kaplan. Drawing mash-ups: and artist's encounter with NPAR. 11 pages, in preparation.
- [2] Rebecca Lin(*) and Craig S. Kaplan. Freeform islamic geometric patterns, 2023.

Articles in refereed journals

- [3] Craig S. Kaplan, Michael O'Keeffe, and Michael M.J. Treacy. Addendum: Periodic diffraction from an aperiodic monohedral tiling—the spectre tiling. *Acta Crystallographica A*, 80(6):460–463, November 2024.
- [4] David Smith, Joseph Samuel Myers, Craig S. Kaplan, and Chaim Goodman-Strauss. A chiral aperiodic monotile. *Combinatorial theory*, 4(2), 2024.
- [5] David Smith, Joseph Samuel Myers, Craig S. Kaplan, and Chaim Goodman-Strauss. An aperiodic monotile. *Combinatorial theory*, 4(1), 2024.
- [6] Craig S. Kaplan, Michael O'Keeffe, and Michael M.J. Treacy. Periodic diffraction from an aperiodic monohedral tiling. *Acta Crystallographica A*, 80(1):72–78, January 2024.
- [7] Craig S. Kaplan. Heesch numbers of unmarked polyforms. *Contributions to Discrete Mathematics*, 17(2):150–171, 2022.
- [8] Lesley Istead, Joe Istead, Andreea Pocol(*), and Craig S. Kaplan. A simple, stroke-based method for gesture drawing. *Virtual Reality & Intelligent Hardware*, 4(5):381–392, 2022.
- [9] Greg Philbrick(*) and Craig S. Kaplan. A Primitive for Manual Hatching. *ACM Transactions on Graphics*, 41(2), jan 2022.
- [10] Craig S. Kaplan and Jeffrey Shallit. A frameless 2-coloring of the plane lattice. *Mathematics Magazine*, 94(5):353–360, 2021.
- [11] Veronika Irvine(**), Therese Biedl, and Craig S. Kaplan. Quasiperiodic bobbin lace patterns. *Journal of Mathematics and the Arts*, 14(3):177–198, 2020.
- [12] Shufang Lu, Wei Jiang, Xuefeng Ding, Craig S. Kaplan, Xiaogang Jin, Fei Gao, and Jiazhou Chen. Depth-aware image vectorization and editing. *The Visual Computer*, 2019(6):1027–1039, 2019 (***).
- [13] Reza Adhitya Saputra(*), Craig S. Kaplan, and Paul Asente. Improved deformation-driven element packing with RepulsionPak. *IEEE Transactions on Visualization and Computer Graphics*, 2019.
- [14] Ali D. Malay, Naoyuki Miyazaki, Artur Biela, Soumyananda Chakraborti, Karolina Majsterkiewicz, Izabela Stupka, Craig S. Kaplan, Agnieszka Kowalczyk, Bernard M. A. G. Piette, Georg K. A. Hochberg, Di Wu, Tomasz P. Wrobel, Adam Fineberg, Manish S. Kushwah, Mitja Kelemen, Primož Vavpetič, Primož Pelicon, Philipp Kukura, Justin L. P. Benesch, Kenji Iwasaki, and Jonathan G. Heddl. An ultra-stable gold-coordinated protein cage displaying reversible assembly. *Nature*, 569:438–442, 2019 (***).
- [15] Shufang Lu, Yue Huang, Xiaogang Jin, Aubrey Jaffer, Craig S. Kaplan, and Xiaoyang Mao. Marbling-based creative modelling. *The Visual Computer*, 33(6-8):913–923, 2017 (***).

- [16] Quirin Stöckl, Davide Bandera, Craig S. Kaplan, Karl-Heinz Ernst, and Jay S. Siegel. Gear-meshed tiling of surfaces with molecular pentagonal stars. *Journal of the American Chemical Society*, 136(2):606–609, 2014 (***).
- [17] Lesley Northam(*), Paul Asente, and Craig S. Kaplan. Stereoscopic 3D image stylization. *Computers & Graphics*, 37(5):389–402, August 2013.
- [18] Tiffany C. Inglis(*), Stephen Inglis(*), and Craig S. Kaplan. Op Art rendering with lines and curves. *Computers & Graphics*, 36(6):607–621, October 2012.
- [19] Yanxi Liu, Hagit Hel-Or, Craig S. Kaplan, and Luc Van Gool. Computational symmetry in computer vision and computer graphics. *Foundations and Trends in Computer Graphics and Vision*, 5(1–2):1–195, June 2010.
- [20] Jie Xu(*) and Craig S. Kaplan. Image-guided maze construction. *ACM Transactions on Graphics*, 26(3):29, July 2007. Proceedings of SIGGRAPH 2007.
- [21] Jie Xu(*) and Craig S. Kaplan. Vortex maze construction. *Journal of Mathematics and the Arts*, 1(1):7–20, March 2007.
- [22] Craig S. Kaplan, Sanjeev Bedi, Stephen Mann, Gilad Israeli(*), and Gilbert Poon(*). A new paradigm for woodworking with NC machines. *The Journal of Computer-Aided Design and Applications*, 1(1–4):217–222, 2004. Also appeared in Proceedings of the CAD’04 conference.
- [23] Craig S. Kaplan and David H. Salesin. Islamic star patterns in absolute geometry. *ACM Trans. Graph.*, 23(2):97–119, 2004.
- [24] Erik D. Demaine, Martin L. Demaine, and Craig S. Kaplan(*). Polygons cuttable by a circular saw. *Comput. Geom. Theory Appl.*, 20(1–2):69–84, 2001. Special issue of selected papers from the 12th annual Canadian conference on computational geometry (CCCG 2000).

Articles in refereed conference proceedings

- [25] Andreea Pocol(*), Lesley Istead, and Craig S. Kaplan. Evaluating and improving disparity maps without ground truth. In Kohei Arai, editor, *Intelligent Systems Conference (IntelliSys) 2024*, pages 153–177. Springer Nature, 2024.
- [26] Craig S. Kaplan. Detecting Isohedral Polyforms with a SAT Solver. In Srečko Brlek and Luca Ferrari, editors, *Proceedings of the 13th edition of the conference on Random Generation of Combinatorial Structures. Polyominoes and Tilings*, volume 403 of *Electronic Proceedings in Theoretical Computer Science*, pages 118–122. Open Publishing Association, 2024.
- [27] John Berglund and Craig S. Kaplan. Large Islamic Rosettes in an Octagonal Frame. In Helena Verrill, Karl Kattchee, S. Louise Gould, and Eve Torrence, editors, *Proceedings of Bridges 2024: Mathematics, Art, Music, Architecture, Culture*, pages 139–146, Phoenix, Arizona, 2024. Tessellations Publishing.
- [28] Craig S. Kaplan. Periodic Strips from Aperiodic Tiles. In Helena Verrill, Karl Kattchee, S. Louise Gould, and Eve Torrence, editors, *Proceedings of Bridges 2024: Mathematics, Art, Music, Architecture, Culture*, pages 131–138, Phoenix, Arizona, 2024. Tessellations Publishing.

- [29] Saralin Zassman, Craig S. Kaplan, and Daniel Vogel. Mindful Scroll: An Infinite Scroll Abstract Colouring App for Mindfulness. In *Proceedings of the CHI Conference on Human Factors in Computing Systems*, New York, NY, USA, 2024. Association for Computing Machinery.
- [30] Craig S. Kaplan. Dichromatic steganography. In Judy Holdener, Eve Torrence, Chamberlain Fong, and Katherine Seaton, editors, *Proceedings of Bridges 2023: Mathematics, Art, Music, Architecture, Culture*, pages 173–180, Phoenix, Arizona, 2023. Tessellations Publishing.
- [31] Cheryl Lao(*), Craig S. Kaplan, Daniel Vogel, Jose Echevarria, and Paul Asente. Generating Packed Rectilinear Display Text Layouts with Weighted Word Emphasis. In *Proceedings of Graphics Interface 2021*, 2023.
- [32] Cheryl Lao(*), Yanting Zhang(*), Daniel Vogel, Craig S. Kaplan, Morgan McGuire, and Victor B. Zordan. A Preliminary Study of World Customizability for Virtual Reality Co-Play. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*, CHI EA '23, New York, NY, USA, 2023. Association for Computing Machinery.
- [33] Lesley Istead, Andreea Pocol(*), Sherman Siu(*), William Chen(*), Alex Zdanowicz(*), Alex Rowaan(*), and Craig S. Kaplan. The colour of horror. In *Proceedings of the 19th ACM SIGGRAPH European Conference on Visual Media Production*, CVMP '22, New York, NY, USA, 2022. Association for Computing Machinery.
- [34] Craig S. Kaplan. Generative Zellij. In David Reimann, Douglas Norton, and Eve Torrence, editors, *Proceedings of Bridges 2022: Mathematics, Art, Music, Architecture, Culture*, pages 285–288, Phoenix, Arizona, 2022. Tessellations Publishing.
- [35] John Berglund and Craig S. Kaplan. Beyond the Great 96. In David Swart, Frank Farris, and Eve Torrence, editors, *Proceedings of Bridges 2021: Mathematics, Art, Music, Architecture, Culture*, pages 31–38, Phoenix, Arizona, 2021. Tessellations Publishing.
- [36] Craig S. Kaplan. Animated Map Colourings of Hinged Squares. In David Swart, Frank Farris, and Eve Torrence, editors, *Proceedings of Bridges 2021: Mathematics, Art, Music, Architecture, Culture*, pages 23–30, Phoenix, Arizona, 2021. Tessellations Publishing.
- [37] Lesley Istead, Andreea Pocol(*), Craig S. Kaplan, Isaac Watt(*), Nick Lemoing(*), and Alicia Yang(*). Generating Rough Stereoscopic 3D Line Drawings from 3D Images. In *Proceedings of Graphics Interface 2021*, GI 2021, pages 178–185. Canadian Information Processing Society, 2021.
- [38] Reza Adhitya Saputra(*), Craig S. Kaplan, and Paul Asente. AnimationPak: packing elements with scripted animations. In *Proceedings of Graphics Interface 2020*, GI 2020, pages 393–403. Canadian Human-Computer Communications Society / Société canadienne du dialogue humain-machine, 2020.
- [39] Greg Philbrick(*) and Craig S. Kaplan. Defining hatching in art. In Craig S. Kaplan, Angus Forbes, and Stephen DiVerdi, editors, *ACM/EG Expressive Symposium*. The Eurographics Association, 2019.
- [40] Craig S. Kaplan. Animated isohedral tilings. In Susan Goldstine, Douglas McKenna, and Kristóf Fenyvesi, editors, *Proceedings of Bridges 2019: Mathematics, Art, Music, Architecture, Education, Culture*, pages 99–106, Phoenix, Arizona, 2019. Tessellations Publishing.
- [41] Reza Adhitya Saputra(*), Craig S. Kaplan, and Paul Asente. RepulsionPak: deformation-driven element packing with repulsion forces. In *Proceedings of the 44th Graphics Interface Conference*, GI '18,

- pages 10–17. Canadian Human-Computer Communications Society / Société canadienne du dialogue humain-machine, 2018.
- [42] Craig S. Kaplan. Interwoven Islamic geometric patterns. In David Swart, Carlo H. Séquin, and Kristóf Fenyvesi, editors, *Proceedings of Bridges 2017: Mathematics, Art, Music, Architecture, Education, Culture*, pages 71–78, Phoenix, Arizona, 2017. Tessellations Publishing.
 - [43] Reza Adhitya Saputra(*), Craig S. Kaplan, Paul Asente, and Radomír Měch. FLOWPAK: flow-based ornamental element packing. In *Proceedings of the 43rd Graphics Interface Conference, GI '17*, pages 8–15. Canadian Human-Computer Communications Society, 2017.
 - [44] Karl Kattchee and Craig S. Kaplan. Combinatorial poppies. In Eve Torrence, Bruce Torrence, Carlo Séquin, Douglas McKenna, Kristóf Fenyvesi, and Reza Sarhangi, editors, *Proceedings of Bridges 2016: Mathematics, Music, Art, Architecture, Education, Culture*, pages 111–118, Phoenix, Arizona, 2016. Tessellations Publishing.
 - [45] Craig S. Kaplan. Hypocycloid juggling patterns. In Eve Torrence, Bruce Torrence, Carlo Séquin, Douglas McKenna, Kristóf Fenyvesi, and Reza Sarhangi, editors, *Proceedings of Bridges 2016: Mathematics, Music, Art, Architecture, Education, Culture*, pages 71–78, Phoenix, Arizona, 2016. Tessellations Publishing.
 - [46] Zhifu Xiao(*), Robert Bosch, Craig S. Kaplan, and Robert J. Lang. Modular origami halftoning: theme and variations. In Kelly Delp, Craig S. Kaplan, Douglas McKenna, and Reza Sarhangi, editors, *Proceedings of Bridges 2015: Mathematics, Music, Art, Architecture, Culture*, pages 61–68, Phoenix, Arizona, 2015. Tessellations Publishing.
 - [47] Craig S. Kaplan. The design of a reconfigurable maze. In George Hart Gary Greenfield and Reza Sarhangi, editors, *Proceedings of Bridges 2014: Mathematics, Music, Art, Architecture, Culture*, pages 167–174, Phoenix, Arizona, 2014. Tessellations Publishing.
 - [48] Craig S. Kaplan and Chris Jordan. The monumental geometry of E Pluribus Unum. In *Proceedings of the Workshop on Computational Aesthetics, CAe '14*, pages 97–102, New York, NY, USA, 2014. ACM.
 - [49] Zainab AlMeraj(*), Craig S. Kaplan, and Paul Asente. Patch-based geometric texture synthesis. In *Proceedings of the Workshop on Computational Aesthetics, CAe '13*, pages 15–19. ACM Press, 2013.
 - [50] Zainab AlMeraj(*), Craig S. Kaplan, and Paul Asente. Towards effective evaluation of geometric texture synthesis algorithms. In *Proceedings of the Symposium on Non-Photorealistic Animation and Rendering, NPAR '13*, pages 5–14. ACM Press, 2013.
 - [51] Tiffany C. Inglis(*), Daniel Vogel(**), and Craig S. Kaplan. Rasterizing and antialiasing vector line art in the pixel art style. In *Proceedings of the Symposium on Non-Photorealistic Animation and Rendering, NPAR '13*, pages 25–32. ACM Press, 2013.
 - [52] Craig S. Kaplan. Grid-based decorative corners. In George Hart and Reza Sarhangi, editors, *Proceedings of Bridges 2013: Mathematics, Music, Art, Architecture, Culture*, pages 317–324, Phoenix, Arizona, 2013. Tessellations Publishing.
 - [53] Tiffany C. Inglis(*) and Craig S. Kaplan. Animating line-based Op Art. In George Hart and Reza Sarhangi, editors, *Proceedings of Bridges 2013: Mathematics, Music, Art, Architecture, Culture*, pages 159–166, Phoenix, Arizona, 2013. Tessellations Publishing.

- [54] Tiffany C. Inglis(*) and Craig S. Kaplan. Circle patterns in Gothic architecture. In Robert Bosch, Douglas McKenna, and Reza Sarhangi, editors, *Proceedings of Bridges 2012: Mathematics, Music, Art, Architecture, Culture*, pages 133–140, Phoenix, Arizona, 2012. Tessellations Publishing.
- [55] Tiffany C. Inglis(*) and Craig S. Kaplan. Pixelating vector line art. In *Proceedings of the Symposium on Non-Photorealistic Animation and Rendering*, NPAR '12, pages 21–28, Aire-la-Ville, Switzerland, Switzerland, 2012. Eurographics Association.
- [56] Lesley Northam(*), Paul Asente, and Craig S. Kaplan. Consistent stylization and painterly rendering of stereoscopic 3D images. In *Proceedings of the Symposium on Non-Photorealistic Animation and Rendering*, NPAR '12, pages 47–56, Aire-la-Ville, Switzerland, Switzerland, 2012. Eurographics Association.
- [57] Craig S. Kaplan. Smooth self-similar curves. In Reza Sarhangi and Carlo H. Séquin, editors, *Proceedings of Bridges 2011: Mathematics, Music, Art, Architecture, Culture*, pages 209–216, Phoenix, Arizona, 2011. Tessellations Publishing.
- [58] Tiffany C. Inglis(*) and Craig S. Kaplan. Sudoku art. In Reza Sarhangi and Carlo H. Séquin, editors, *Proceedings of Bridges 2011: Mathematics, Music, Art, Architecture, Culture*, pages 187–194, Phoenix, Arizona, 2011. Tessellations Publishing.
- [59] Tiffany C. Inglis(*) and Craig S. Kaplan. Generating Op Art lines. In *International Symposium on Computational Aesthetics in Graphics, Visualization, and Imaging*, pages 25–32, 2011.
- [60] Zainab AlMeraj(*), Craig S. Kaplan, Paul Asente, and Edward Lank. Towards ground truth in geometric textures. In *Proceedings of the ACM SIGGRAPH/Eurographics Symposium on Non-Photorealistic Animation and Rendering*, NPAR '11, pages 17–26, New York, 2011. ACM Press.
- [61] Lesley Northam(*), Joe Istead, and Craig S. Kaplan. RTFX: on-set previs with UnrealEngine3. In *Proceedings of the 10th International Conference on Entertainment Computing (ICEC 2011)*, 2011. 4 pages.
- [62] Daniel Berry and Craig S. Kaplan. Planned programming problem gotchas as lessons in requirements engineering. In *Proceedings of the 5th International Workshop on Requirements Engineering Education and Training (REET 2010)*, pages 20–25. IEEE, 2010.
- [63] Craig S. Kaplan. Curve evolution schemes for parquet deformations. In *Bridges 2010: Mathematical Connections in Art, Music and Science*, pages 95–102, 2010.
- [64] Kate Kinneer(*) and Craig S. Kaplan. Procedural generation of surface detail for science fiction spaceships. In Pauline Jepp and Oliver Deussen, editors, *Workshop on Computational Aesthetics*, pages 83–90, London, UK, 2010. Eurographics Association.
- [65] Lesley Northam(*), Joe Istead, and Craig S. Kaplan. Brush stroke ordering techniques for painterly rendering. In Pauline Jepp and Oliver Deussen, editors, *Workshop on Computational Aesthetics*, pages 59–66, London, UK, 2010. Eurographics Association.
- [66] Craig S. Kaplan. Semiregular patterns on surfaces. In *NPAR '09: Proceedings of the 7th international symposium on Non-photorealistic animation and rendering*, pages 35–39, New York, 2009. ACM Press.
- [67] Alex Kalaidjian(*), Craig S. Kaplan, and Stephen Mann. Automated landscape painting in the style of Bob Ross. In Oliver Deussen and Peter Hall, editors, *Computational Aesthetics in Graphics, Visualization, and Imaging*, pages 115–122, Victoria, British Columbia, Canada, 2009. Eurographics Association.

- [68] Jeff Orchard and Craig S. Kaplan. Cut-out image mosaics. In *NPAR '08: Proceedings of the 6th international symposium on Non-photorealistic animation and rendering*, pages 79–87, New York, 2008. ACM Press.
- [69] Jie Xu(*) and Craig S. Kaplan. Artistic thresholding. In *NPAR '08: Proceedings of the 6th International Symposium on Non-Photorealistic Animation and Rendering*, pages 39–47, New York, 2008. ACM Press.
- [70] Zheng Qin(*), Michael D. McCool, and Craig S. Kaplan. Precise vector textures for real-time 3D rendering. In *SI3D '08: Proceedings of the 2008 symposium on Interactive 3D graphics and games*, pages 199–206. ACM Press, 2008.
- [71] Craig S. Kaplan. Metamorphosis in Escher’s art. In *Bridges 2008: Mathematical Connections in Art, Music and Science*, pages 39–46, 2008.
- [72] Jie Xu(*), Craig S. Kaplan, and Xiaofeng Mi(*). Computer-generated papercutting. In *PG '07: 15th Pacific Conference on Computer Graphics and Applications*, pages 343–350, 2007.
- [73] Jie Xu(*) and Craig S. Kaplan. Calligraphic packing. In *GI '07: Proceedings of the 2007 conference on Graphics interface*, pages 43–50. Canadian Human-Computer Communications Society, 2007.
- [74] Jie Xu(*) and Craig S. Kaplan. Vortex maze construction. In *Bridges 2006: Mathematical Connections in Art, Music and Science*, pages 301–308, 2006.
- [75] Celine Latulipe(*), Ian Bell, Charles L. A. Clarke, and Craig S. Kaplan. symTone: two-handed manipulation of tone reproduction curves. In *GI '06: Proceedings of the 2006 conference on Graphics interface*, pages 9–16. Canadian Information Processing Society, 2006.
- [76] Craig S. Kaplan. A meditation on Kepler’s Aa. In *Bridges 2006: Mathematical Connections in Art, Music and Science*, pages 465–472, 2006.
- [77] Celine Latulipe(*), Stephen Mann, Craig S. Kaplan, and Charles L. A. Clarke. symSpline: symmetric two-handed spline manipulation. In *CHI '06: Proceedings of the SIGCHI conference on Human Factors in computing systems*, pages 349–358. ACM Press, 2006.
- [78] Zheng Qin(*), Michael D. McCool, and Craig S. Kaplan. Real-time texture-mapped vector glyphs. In *I3D '06: Proceedings of the 2006 symposium on Interactive 3D graphics and games*, pages 125–132. ACM Press, 2006.
- [79] Celine Latulipe(*), Craig S. Kaplan, and Charles L. A. Clarke. Bimanual and unimanual image alignment: an evaluation of mouse-based techniques. In *UIST '05: Proceedings of the 18th annual ACM symposium on User interface software and technology*, pages 123–131. ACM Press, 2005.
- [80] Celine Latulipe(*), Craig S. Kaplan, and Charles L. A. Clarke. Simultaneous rotation and translation. In *HCI 2005 Proceedings, Volume 2*, pages 63–67. The British Computer Society, 2005.
- [81] Craig S. Kaplan and Robert Bosch. TSP art. In *Bridges 2005: Mathematical Connections in Art, Music and Science*, pages 301–308, 2005.
- [82] Craig S. Kaplan. Aliasing artifacts and accidental algorithmic art. In *Bridges 2005: Mathematical Connections in Art, Music and Science*, pages 349–356, 2005.
- [83] Craig S. Kaplan. Islamic star patterns from polygons in contact. In *GI '05: Proceedings of the 2005 conference on Graphics interface*, pages 177–185. Canadian Human-Computer Communications Society, 2005.

- [84] Craig S. Kaplan and David H. Salesin. Dihedral Escherization. In *GI '04: Proceedings of the 2004 conference on Graphics interface*, pages 255–262. Canadian Human-Computer Communications Society, 2004.
- [85] Craig S. Kaplan(*) and George W. Hart. Symmetrohedra: polyhedra from symmetric placement of regular polygons. In *Bridges 2001: Mathematical Connections in Art, Music and Science*, pages 21–28, 2001.
- [86] Craig S. Kaplan(*). A computer analysis of Boggle™. In *POCSI433, Problems of Computer Science in Room 433*, 2001. 3 pages.
- [87] Craig S. Kaplan(*) and David H. Salesin. Escherization. In *SIGGRAPH '00: Proceedings of the 27th annual conference on Computer graphics and interactive techniques*, pages 499–510. ACM Press/Addison-Wesley Publishing Co., 2000.
- [88] Craig S. Kaplan(*). Computer generated Islamic star patterns. In *Bridges 2000: Mathematical Connections in Art, Music and Science*, pages 105–112, 2000.
- [89] Craig S. Kaplan(*). Voronoi diagrams and ornamental design. In *ISAMA'99: The first annual symposium of the International Society for the Arts, Mathematics, and Architecture*, pages 277–283, 1999.
- [90] Michael Ernst(*), Craig S. Kaplan(*), and Craig Chambers. Predicate dispatching: a unified theory of dispatch. In *ECCOP '98: Proceedings of the 12th European Conference on Object-Oriented Programming*, pages 186–211. Springer-Verlag, 1998.

Chapters in books

- [91] Craig S. Kaplan. The tiles, they are a-changin'. In Werner Van Hoeydonck, Christian Kern, and Eva Sommeregger, editors, *Space Tessellations: Experimenting with Parquet Deformations*, pages 109–126. Birkhauser, 2022.
- [92] Jay Bonner. *Islamic Geometric Patterns: Their Historical Development and Traditional Methods of Construction*, chapter 4, pages 549–573. Springer-Verlag New York, 2017.
- [93] Craig S. Kaplan. Depiction using geometric constraints. In Paul Rosin and John Collomosse, editors, *Image and Video-Based Artistic Stylization*, volume 42, pages 167–187. Springer London, 2012.
- [94] Craig S. Kaplan and Robert Bosch. Operations research in the visual arts. In *Wiley Encyclopedia of Operations Research and Management Science*. John Wiley & Sons, Inc., 2010. 15 pages.

Books

- [95] Stephen DiVerdi, Craig S. Kaplan, Angus G. Forbes, and Chiara Eva Catalano, editors. *ACM/EG Expressive Symposium*. The Eurographics Association, 2019.
- [96] Kelly Delp, Craig S. Kaplan, Douglas McKenna, and Reza Sarhangi, editors. *Proceedings of Bridges 2015: Mathematics, Music, Art, Architecture, Culture*, Phoenix, Arizona, 2015. Tessellations Publishing.
- [97] Craig S. Kaplan. *Introductory Tiling Theory for Computer Graphics*. Morgan & Claypool, July 2009.

- [98] Tobias Isenberg, Craig S. Kaplan, and Stephen N. Spencer, editors. *NPAR '09: Proceedings of the 7th international symposium on Non-photorealistic animation and rendering*, New York, 2009. ACM.
- [99] Craig S. Kaplan and Reza Sarhangi, editors. *Proceedings of Bridges 2009: Mathematics, Music, Art, Architecture, Culture*, Hertfordshire, UK, 2009. Tarquin Books.
- [100] Aaron Hertzmann, Craig S. Kaplan, and Stephen N. Spencer, editors. *NPAR '04: Proceedings of the 3rd international symposium on Non-photorealistic animation and rendering*, New York, 2004. ACM.

Artworks in juried exhibitions

- [101] “A (More) Complete Cross Stitch Symmetry Sampler”. Triaxial polyester fabric and thread, Bridges 2019 exhibition of visual art, Linz, Austria, 2019.
- [102] “Tending towards the convex”. Digital print, Bridges 2015 exhibition of visual art, Baltimore, USA, 2015.
- [103] “Glitch” and “Flattened Sphere”. Laser-cut wooden marquetry, Bridges 2014 exhibition of visual art, Seoul, South Korea, 2014.
- [104] “Laves parquet deformation”. Digital print, FAX + Pattern exhibition, Simons Center for Geometry and Physics, Stony Brook, New York, 2013.
- [105] “Two woven Islamic star patterns”. Two paper sculptures in the 2013 Bridges conference art exhibition, Enschede, The Netherlands, 2013.
- [106] “Islamic patterns”. Four Islamic geometric patterns in the *Design & Computation* exhibit, a curated art exhibit at the SIGGRAPH 2008 conference, Los Angeles, California, 2008.
- [107] “Leo” and “Islamic metamorphosis #2”. Two artworks in the Second Joint AMS/MAA Exhibit on Mathematical Art, San Antonio, Texas, 2006. The same works appeared in the Exhibit of Mathematical Art at the 2006 Bridges conference in London, England.
- [108] Four artworks in the First International Exhibition of Voronoi Art, Seoul, Korea, 2005.

Other publications

- [109] Craig S. Kaplan. The path to aperiodic monotiles. Invited article for *Eureka*, the journal of the Archimedean, the Cambridge University mathematics student society, 2025.
- [110] Craig S. Kaplan. The missing piece: the quest for an einstein tile—a shape never seen before in mathematics. *Scientific American*, 330(1):58–67, January 2024
- [111] Craig S. Kaplan. Report: Geometry: education, art, and research (GEAR 2021). *Journal of Mathematics and the Arts*, 15(2):201–206, 2021.
- [112] Craig S. Kaplan. Book review: Math Art: Truth, Beauty, and Equations. *Journal of Mathematics and the Arts*, 13(3):305–307, 2019.
- [113] Craig S. Kaplan. Book review: Visualizing Mathematics with 3D Printing. *The College Mathematics Journal*, 48(1):69–72, 2017.

- [114] Craig S. Kaplan. Book review: Processing: A Programming Handbook for Visual Designers and Artists. *Journal of Mathematics and the Arts*, 2(4):211–214, December 2008.
- [115] Craig S. Kaplan. The trouble with five. *Plus Magazine*, December 2007. 15 pages. Invited article on five-fold tilings.
- [116] Craig S. Kaplan. The design space of Islamic star patterns. In Amir Esfahani, editor, *Enlightenment through creativity: collaboration of the arts and sciences*, pages 3–7. 2006. Invited essay to accompany an exhibition of Esfahani’s art.
- [117] Craig S. Kaplan(*). *Computer Graphics and Geometric Ornamental Design*. PhD thesis, Department of Computer Science & Engineering, University of Washington, 2002.

Other scholarship

Invited addresses

This section includes all invited addresses delivered to a technical or academic audience. It includes keynotes and other invited talks at academic conferences as well as colloquia at universities. See “high school liaison and outreach activities” under Service for invited talks given to high school students or the general public.

Computing Tiling Properties of Polyforms. Invited talk for the Penn State Geometry Lunch-Time Seminar. Online, 13 November 2024.

The role of amateurs in tiling theory. Invited talk for “Points, Lines, Angles & Shapes”, a symposium on mathematics and art at Carleton College. Northfield, Minnesota, 11 October 2024.

Computing Tiling Properties of Polyforms. Invited talk for the Mathematics and Computer Science Department at St. Olaf College. Northfield, Minnesota, 10 October 2024.

Tilings in art and design. Invited talk for Huawei Vancouver Graphics Technology Lab. Online, 19 August 2024.

Computing Tiling Properties of Polyforms. Invited keynote at the GASCom 2024 conference. Bordeaux, France, 24 June 2024.

Decorative and mathematical tilings. Invited talk for LaBRI at the University of Bordeaux. Bordeaux, France, 17 June 2024.

Computing Tiling Properties of Polyforms. Invited talk for TU Munich Mathematics Colloquium. Garching, Germany, 6 June 2024.

Aperiodic Monotiles: (New) Shapes (Just) Dropped. Invited talk for Toronto ACM SIGGRAPH Chapter. Toronto, Ontario, 30 May 2024.

Near misses in science and art. Invited talk for the MS2Discovery Interdisciplinary Research Institute, Wilfrid Laurier University, Waterloo, Canada, April 2024.

Aperiodic monotiles: new shapes just dropped. Invited Tamura Lilly Lecture at Oberlin College, Oberlin, USA, November 2023.

Aperiodic monotiles. Invited talk at Western University Mathematics Colloquium, November 2023.

Aperiodic monotiles. Invited talk at San Jose State Mathematics Colloquium, Online, October 2023.

An aperiodic monotile: new shape(s) just dropped. Invited keynote at Bridges 2023, Halifax, Canada, July 2023.

Heesch numbers of unmarked polyforms. Invited talk at CanaDAM 2023, Winnipeg, Canada, June 2023.

An aperiodic monotile: new shape(s) just dropped. Invited keynote at Graphics Interface 2023, Victoria, Canada, June 2023.

An aperiodic monotile. Invited talk for One World Combinatorics on Words Seminar, Online, May 2023.

An aperiodic monotile. Invited talk for One World Numeration Seminar, Online, May 2023.

Representation and manipulation of isohedral tilings. Invited talk for the Seminário de Computação Gráfica at IMPA (Rio), Online, April 2022.

Swirled Series: an online collaborative geometric animation. Invited talk at GEAR 2021, online, 2021.

Mathematical and Computational aspects of Islamic Geometric Patterns. Invited talk at Jagiellonian University, Kraków, October 2017.

Adventures in tiling theory, old and new. Invited talk for the Combinatorics on Words and Tilings workshop at the Centre De Recherches Mathématiques, Montréal, April 2017.

Mathematics and Computation in Halftoning. Invited talk for the math education forum at the Fields Institute, Toronto, March 2017.

Pack, cover, surround: computer-generated tilings in art and design. Keynote talk at the FUN With Algorithms 2016 conference, June 2016.

A close encounter with near misses. Invited talk at Inria Rhône-Alpes, Grenoble, France, December 2015.

A close encounter with near misses. Keynote talk at the 2015 WatITis conference, University of Waterloo, December 2015.

Mysterious Mystical Mysteries, invited (and improvised) talk at the Sir Nathan Sham lecture series, University of Waterloo, January 2015.

Computer-based design of Islamic geometric patterns. Invited talk for the Studies in Islam Speaker Series, University of Waterloo, November 2014.

Metamorphoses and deformations of tilings. Invited talk at the Berlin Mathematical Society, Berlin, June 2014.

Generation and transformation of Islamic star patterns. Invited talk at the University of Granada, Spain, May 2014.

Pixelating vector art. Invited talk the University of Bath, UK, April 2014.

Computer-generated Op Art from lines and curves. Invited talk at the Computer Arts Society, London, November 2013.

Prosthetics and 3D Printing. Invited talk at the Technical Symposium of the Canadian Association of Prosthetics and Orthotics, June 2013.

Filling the universe with Tetris pieces and other mysteries of tiling theory. Invited talk at Excellence in Mathematics Awards Night, Waterloo, Ontario, May 2013.

Islamic star patterns in absolute geometry. Invited presentation at P-AGE 2008, Pécs, Hungary, June 2008.

Escherization. Invited presentation at the 2007 Spring southeastern section meeting of the AMS, special session on computational and combinatorial aspects of tilings and substitutions, 2007.

Complexity and aesthetics in computer-generated mazes. Invited presentation at Oberlin College, November 2006. Also presented at Moravian College, November 2006.

Ornamental design freed of every blemish. Invited presentation at the annual meeting of the Grand Valley Math Association, October 2005.

Current research. Invited presentation at CORE Feature Animation, April 2005.

The geometry of Snakes. Invited presentation at School of Computer Science invitational lecture series, October 2003.

Thesis supervision

Brian Do, PhD, September 2024–

Zane Wang, MMath, 2023–

Lee Fryer-Davis, MMath, 2023–

Andreea Pocol, PhD, 2021–.

Saralin Zassman, MMath, 2021–2023.
Mindless Scroll: An Infinite Scroll Abstract Colouring App for Mindfulness

Cheryl Lao, MMath, 2020–2023.
Perceptual Allowances of Anamorphic Interaction Cues in Spatial Augmented Reality

Gregory Philbrick, PhD, 2017–.
Writing My Own Line Drawing Software as an Artist

Heng (Clara) Kang, MMath, 2018–2021.
Generating patterns on clothing for seamless design

Reza Adhitya Saputra, PhD, 2014–2020.
Deformation-Driven Element Packing

Lesley Istead, PhD, 2011–2018.
Towards Better Methods of Stereoscopic 3D Media Adjustment and Stylization

Tiffany Inglis, PhD, 2009–2013.
Pixelating Vector Art

Zainab AlMeraj, PhD, 2008–2013.
Synthesis and evaluation of geometric textures

Kate Kinnear, MMath, 2007–2010.
The aesthetics of science fiction spaceship design

Zheng Qin, PhD, 2005–2009.
Vector Graphics for Real-time 3D Rendering

Jie Xu, PhD, 2003–2009.
Wholetoning: Synthesizing Abstract Black-and-White Illustrations

Paul Church, MMath, 2005–2008.
Snakes in the Plane

Alex Kalaidjian, MMath, 2006–2007.

Automatic landscape painting in the style of Bob Ross

Celine Latulipe, PhD, 2004–2006.

A Symmetric Interaction Model of Bimanual Input

Postdoctoral supervision

Zach McKendrick, PDF, 2024– (co-supervised with Daniel Vogel and Andrew Houston, Provost’s Program for Interdisciplinary Postdoctoral Scholars)

Veronika Irvine, PDF, 2016–2020 (co-supervised with Therese Biedl).

Daniel Vogel, PDF, 2011–2013 (co-supervised with Bill Cowan, NSERC Banting Postdoctoral Fellowship).

Other student supervision

Shalini Aggarwal, special project, 2005.

Post-MMath research project on computer-assisted painting algorithms.

Michael Wasilewski, MMath essay, 2003–2004.

Essay: Tools for Graftal Placement and Rendering.

Undergraduate research supervisor for Edgar W. Bering IV, Dmitry Chechik, Xinyuan Fan, Haowei Gao, Niki Hasrati, Nancy Iskander, Roman Karatchinsky, Nanji (Leon) Jiang, James Lee, Patrick Lee, Mulong Li, Rebecca Lin, Chenhang (Frank) Liu, Saiyue Lyu, Volodymyr Lyubinetz, Tara Munikar, Yomna Nasser, Ava Pun, Yutian Tao, Sumair Ur Rahman, Kenneth Rose, Gracie Xia, Michael Yang, Caitlyn Zhang.

Professional activities

Outreach and liaison activities

Introduction to tilings. Six-hour hands-on workshop for SHAD 2024, Waterloo, July 2024.

Computer Graphics. Presentation for high school students at CEMC’s Seeing Possibilities and Rewards in Computer Science (SPARCS). Waterloo, Ontario, 13 May 2024.

Aperiodic monotiles: new shapes just dropped. Invited talk at The National Museum of Mathematics, New York City, USA, October 2023.

An aperiodic monotile: new shape just dropped. Invited talk for SHAD 2023, Waterloo, July 2023.

An aperiodic monotile: meet the authors. Invited talk for National Museum of Mathematics, given jointly with David Smith, Joseph Myers, and Chaim Goodman-Strauss, Online, March 2023.

A hat for einstein. Invited talk for National Museum of Mathematics, given jointly with David Smith, Joseph Myers, and Chaim Goodman-Strauss, Online, March 2023.

The professor in his native habitat. Online presentation for Earl Marriott Secondary School in Surrey, BC, 2022.

Panel: Data + The Arts. Invited as panel moderator with panelists Rob Gorbett, Marcel O’Gorman, and Jane Tingley. Waterloo, Canada, October 2022.

Two pentagon constructions. Invited (recorded) talk for the Julia Robinson Mathematics Festival 24-Hour Math Buffet, Online, 2021.

Judge for “Conway Criterion Art Contest”, Museum of Mathematics, 2021.

Parquet deformations: the tiles, they are a-changin’. Invited talk for Gathering4Gardner Celebration of Mind, Online, April 2021.

Geometric Sculpture. One-week Shad Valley workshop, Waterloo, Canada, 2007, 2009, 2010, 2012, 2015, 2016, 2019, 2020.

How to Draw a Tiling. Invited workshop for the Lloyd Aukland Invitational Mathematics Workshop, Waterloo, Canada, 2019.

How to Draw a Tiling. Invited workshop for Canadian Computing Olympiad winners, Waterloo, Canada, 2019.

Animated Tilings. Talk for the Computer Science Club, 2019.

Near Misses in Mathematics, Art, and Science. Invited talk at QCSYS 2019, Waterloo, 2019.

Adventures in Computational Art: Moving Points Around. Keynote talk for FTLOMACS (For the Love of Math and Computer Science), Waterloo, October 2017.

Tilings from convex polygons. Invited talk for the Lloyd Aukland Invitational Workshop, Waterloo, May 2017.

Art and Mathematics. Invited presentation for Grade 6 students at Elizabeth Ziegler Public School, June 2017.

On surrounding a polygon. Invited talk for the Lloyd Aukland Invitational Mathematics Workshop, University of Waterloo, June 2016.

1123581321. Invited talk for the Canadian Computing Olympiad Stage 2, May 2016.

On surrounding a polygon. Invited talk for Computer Science Club, University of Waterloo, April 2016.

On surrounding a polygon. Invited talk for EMACS 2015 (Exploring Mathematics and Computer Science at Waterloo), University of Waterloo, October 2015.

Surrounding a shape and other unsolved mysteries. Keynote talk for the Canadian Computing Olympiad, May 2015.

Introduction to Computer Science, March Break Open House, 2015.

Surrounding a shape and other unsolved mysteries. Keynote talk for the Canadian Team Mathematics Contest, April 2015.

The forest and the trees. Invited talk for the Bridges Lecture Series, delivered jointly with Linda Carson, University of Waterloo, November 2014.

Two shades of grey: the art and science of halftoning. Invited talk for MoSAIC, New York City, October 2014.

Revolution and evolution in math and design. Invited talk and hands-on workshop at Math Encounters, a lecture series organized by the Museum of Mathematics, New York City, 2012.

Introduction to Processing, workshop for CS Educators Summer Conference, 2011, 2015.

Revolutions in mathematics and the evolution of design. Invited talk at Transcending Differences: Tiling in Islamic and Western Culture, University of Michigan-Dearborn, 2011.

Disorderly tiles, orderly non-tiles, and the path to aperiodicity. Invited talk University of Michigan-Dearborn, 2011.

Celtic Knotwork, Think About Math presentation, 2010, 2011.

Introduction to computer graphics, CEMC Workshop in Computer Science for Young Women, 2003–2009, 2011, 2015–2016

Creating artistic images using halftoning. Presentation at the 2010 International Olympiad of Informatics, 2010.

Mathematical art and artistic mathematicians. Invited presentation at the Quantum to Cosmos festival, Waterloo, Ontario, October 2009.

Some computational properties of polyominoes, talk for top competitors in the Canadian Computing Competition, 2009.

Talk and lab tours for CEMC Math Teachers Workshop, 2009.

Ontario Universities Fair, Toronto, Canada, 2004, 2008, 2009.

Jumpstart Friday (incoming students), Waterloo, Canada, 2008–2009

Rapid prototyping and mathematical art. Talk for the Computer Science Club, 2008.

Introduction to computer science. CS Exposed, Waterloo, Canada, 2006–2007

Introduction to computer science. Campus day, Waterloo, Canada, 2005–2006.

A whirlwind tour of computer graphics. CS4U@Waterloo day, Waterloo, Canada, 2005–2006.

Society memberships and positions held

Lifetime member of ACM

Member of ACM SIGGRAPH

Editorial positions

Associate Editor, Journal of Mathematics and the Arts, 2007–2012, 2017–present.

Editor-in-chief, Journal of Mathematics and the Arts, 2012–2017.

Conference organization

Member of the board of the Bridges Organization since 2005. The Bridges Organization oversees the annual Bridges conferences on art and mathematics. I participate in executive-level decision making, and manage a large amount of annual operations (website, mailing list, papers archive, proceedings production, etc.).

Member of the steering committee for the Expressive conference (formerly the Non-Photorealistic Animation and Rendering conference and the Computational Aesthetics conference).

Member of the steering committee for the Graphics Interface conference.

Co-chair (with Stephen DiVerdi and Angus Forbes) of Expressive 2019, Genoa, Italy.

Courses chair, SIGGRAPH 2018, Vancouver, Canada.

General chair and host, Bridges 2017, Waterloo, Canada.

Workshop chair for Bridges 2015, mathematical connections in art, music, and science, Baltimore, USA.
General chair and papers chair of Bridges 2009, mathematical connections in art, music, and science, Banff, Canada.

Co-chair (with Tobias Isenberg) of NPAR 2009, the Seventh International Symposium on Non-Photorealistic Animation and Rendering, New Orleans, USA.

Co-organizer of Bridges 2005, mathematical connections in art, music, and science, Banff, Canada.

Co-chair (with Aaron Hertzmann) of NPAR 2004, the Third International Symposium on Non-Photorealistic Animation and Rendering, Annecy, France.

Organizer for MOSAIC 2000, The Millennial Open Symposium on the Arts and Interdisciplinary Computing, Seattle, USA.

Refereeing and reviewing for journals and conferences

Conference program committees (excluding chairing): Bridges (2008, 2010, 2011, 2012, 2013, 2014, 2016, 2018, 2019), Computational Aesthetics (2008, 2009, 2010, 2011), Computer Graphics International (2015), EvoMUSART (2010, 2011), Expressive (2013, 2014, 2015, 2016, 2017, 2018, 2025), GECCO Art Exhibition (2013), Graphics Interface (2006, 2011, 2021, 2022, 2025), GRAPP (2006), Non-Photorealistic Animation and Rendering (2007, 2008, 2010, 2011), SIGGRAPH Art Papers (2011), SIGGRAPH Asia courses (2017), SIGGRAPH Unified Jury (2017, 2018), SMI Fabrication and Sculpting Event (2015).

Conference reviewing (last five years / lifetime): Bridges (7/29), CGGM (0/1), COCOON (0/1), Computational Aesthetics (0/3), Computer Graphics International (0/1), Eurographics (4/15), Eurographics Symposium on Rendering (0/1), Expressive (0/5), Graphics Interface (3/12), SIGGRAPH (3/30), SIGGRAPH Asia (2/13), SIGGRAPH Unified Jury (46/82), UIST (1/3)

Journal reviewing (last five years / lifetime): ACM Transactions on Applied Perception (0/1), ACM Transactions on Graphics (8/11), Algorithmica (1/2), Applied Mathematics and Computations (1/1), Computer Aided Design (0/3), Computer Graphics Forum (2/6), Computers and Graphics (2/13), Geometric Models (0/1), IEEE Computer Graphics & Applications (3/3), IEEE Transactions on Visualization and Computer Graphics (3/6), Journal of Computing and Cultural Heritage (0/1), Journal of Discrete Algorithms (0/1), Journal of Computer Graphics Techniques (0/3), Journal of Mathematics and the Arts (9/11), Leonardo (1/1), Mathematical Intelligencer (1/1), Nexus Network Journal (0/1), Notices of the AMS (0/1), Pattern Recognition (0/2), Pattern Recognition Letters (0/1), Symmetry Integrability and Geometry: Methods and Applications (0/1), Symmetry Journal (0/1), Tbilisi Mathematics Journal (0/1), The Visual Computer Journal (2/4),

Miscellaneous review committees: CHCCS Early Career Award selection committee (2021, 2022), NSERC New Media Initiative selection committee (2009, 2010), TVCG Editor-in-chief selection committee (2010).

Miscellaneous reviewing (lifetime): Alberta iCORE (1), BIRS Workshop (1), Book proposals (9), FQRNT (1), Guggenheim Fellowship (1), Israel Science Foundation (1), MacArthur Foundation Fellowship (1), Netherlands Organization for Scientific Research (1), NSERC CRD (2), NSERC Discovery Grant (7), NSERC New Frontiers (1), NSERC New Media Initiative (1), NSERC Strategic Grant (1), MITACS applications (2), Tenure and promotion (Canada) (1), Tenure and promotion (international) (4), UAE Research Funding (1).

Consulting and technology transfer activities

In addition to obvious technology transfer activities (e.g., patents, software libraries), I include a selection of personal projects, commercial or otherwise, which have achieved some measure of exposure or popularity. I consider these projects to be spin-offs of my academic research.

Minimal waste design for manufacturing. Consulting for the Minimal Waste Design team at DECATHLON, 2024–present.

Slide to Unlock (2023): A free touch-based puzzle game that blends topology and manual dexterity. It has been played hundreds of thousands of times since its release in May 2023.

Text importance spatial layout. Cheryl Lao, William F. Kraus, Paul Asente, Jose Echevarria, Craig S. Kaplan, and Daniel Vogel. Patent US11538210B1, applied 2021, granted 2022.

Computerized generation of ornamental designs by placing instances of simple shapes in accordance with a direction guide. Paul Asente, Craig S. Kaplan, Radomír Měch, and Reza Adhitya Saputra. Patent US10559061B2, applied 2017, granted 2020.

Andromeda Reimagined (2019): I designed Islamic geometric patterns that were incorporated into a large pavilion constructed and displayed at the Burning Man festival.

Tactile and TactileJS (2018): I released an open-source library for representing and manipulating isohedral tilings. Available for C++ and JS, with contributed ports to other languages. The JS version has 189 stars on Github.

Paper Good Fences Puzzles (2016): I was invited to create a series of paper-and-pencil Good Fences puzzles for publication in MAA Focus magazine.

Good Fences (2015): A mobile puzzle game for iOS and Android based indirectly on the computation of Heesch numbers. The app is currently unavailable, but I’ve had a rewrite in the works for a few years. Knuth included problems inspired by Good Fences in Volume 4 of *The Art of Computer Programming*.

Printed Mazes (2015): I created several paper-and-pencil maze puzzles based on past research, for publication in the puzzle section of Readers Digest Canada.

Tending Towards the Convex (2015): I was commissioned to create a painterly Islamic geometric pattern for use as a prop in a professional production of the Ayad Akhtar play *Disgraced* in Vienna. It was subsequently used in two or three additional productions around the world.

3D Printed Kippahs (2014): I designed a series of 3D printed kippahs (Jewish head coverings) based on geometric patterns. They were covered by several media outlets, including NPR and the Jerusalem Post. In 2017, one kippah from this collection was included in the exhibit “Is Fashion Modern?” at the Museum of Modern Art in New York City.

Book Cover (2014): Designed a book cover based on Islamic patterns for the Society for Biblical Literature.

Blast Off Espresso Cups (2012): I created an espresso cup shaped like a rocket ship, as an experiment in 3D printed porcelain. The cup received viral attention online and was later licensed to Fred and Friends, where it was developed into a commercial product that was available in stores for a few years.

Beach Maze Toy (2013): Consulted for NewMetro Design on the development of a plastic beach toy based on mazes. The mathematical technique was also published at Bridges 2014.

SpinDraw (2012): A mobile iOS app that simulates an old-fashioned mechanical drawing machine called a HOOT-NANNY, producing intricate geometric patterns. An updated version is still available on the Apple App Store, I sell a handful of copies every month.

MoMath Parquet Deformations (2012): Designed a abstract geometric pattern that was manufactured in low-relief bronze for the window sills and soffits at the main entrance of the National Museum of Mathematics in New York City.

TSP Museum Exhibit (2012): A few days of consulting for the Science Museum of Minnesota on a new exhibit about the Travelling Salesman Problem.