George W. Hart

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RESEARCH AREA:

Multidisciplinary topics in mathematics, computer science, and the arts, centered on sculpture, three-dimensional geometry, and informal education.

EDUCATION:

Ph.D.	Massachusetts Institute of Technology, 1987 Major: Electrical Engineering and Computer Science
M.A.	Indiana University, August 1979 (Formal languages)
B.S.	Massachusetts Institute of Technology, January 1977 (Mathematics)

POSITIONS:

2012-present	Consultant, lecturer, mathematical sculptor, Non-salaried research professor, Stony Brook University
2010-2012	Co-founder and Chief of Content Museum of Mathematics
2002-2010	Research Professor Computer Science Department Stony Brook University
1998–2001	Consultant, lecturer, mathematical sculptor
1995–1998	Associate Professor Computer Science Department Hofstra University
1987–1995	Assistant, then Associate Professor Electrical Engineering Department Columbia University
1981–1987	Research Scientist/Consultant Lincoln Laboratory and the Energy Laboratory Massachusetts Institute of Technology

BOOKS:

G. Hart, *Multidimensional Analysis: Algebras and Systems for Science and Engineering,* Springer Verlag, 1995.

G. Hart and Henry Picciotto, *Zometool Geometry,* Key Curriculum Press, 2001.

G. Hart and Reza Sarhangi, eds., *Proceedings of Bridges 2010,* Pécs, Hungary, Tessellations publ.

G. Hart and Reza Sarhangi, eds., *Proceedings of Bridges 2013,* Enschede, The Netherlands, Tessellations publ.

Gary Greenfield, G. Hart, and Reza Sarhangi, eds., *Proceedings of Bridges 2014,* Seoul, Korea, Tessellations publ.

PAPERS and PRESENTATIONS:

G. Hart and Elisabeth Heathfield, “Making Math Visible,” in Proceedings of Bridges 2017, David Swart et al. eds., pp. 63-70.

G. Hart, review of "Mind-blowing Modular Origami: The Art of Polyhedral Paper Folding, by Byriah Loper" *Journal of Mathematics and the Arts*, to appear 2017.

G. Hart, "Tunnel Cube," *Math Horizons,* Feb. 2016, pp. 22-23.

G. Hart and Elisabeth Heathfield, "Rhombic Triacontahedron Puzzle," in Proceedings of Bridges 2016, Eve Torrence et al. eds., pp. 609-614.

G. Hart, "Kissing Puzzle," *Cubism for Fun*, issue 99, pp. 18-21.

G. Hart, “Cable Tie and Laser-Cut Wood Sculpture,” *Proceedings of Bridges 2015,* Kelly Delp et al. eds., pp. 77-84.

G. Hart, “Geometry Ascending a Staircase,” *Proceedings of Bridges 2014*, Gary Greenfield et al. Eds., pp. 135-142.

Robert Hanson and George Hart, "Custom 3D-Printed Rollers for Frieze Pattern Cookies," *Proceedings of Bridges 2013*.

G. Hart, “Goldberg Polyhedra,” Chapter 9 of *Shaping Space,* 2nd edition, Marjorie Senechal ed., Springer, 2013.

G. Hart, “Computers and Sculpture,” in *Experience-Centered Approach and Visuality in the Education of Mathematics and Physics*, Barallo et al. eds., Kaposvar Univ., Hungary, ISBN 978-963-9821-52-1, 2012.

G. Hart, “Two Playing-Card Puzzle-Sculptures,” *Cubism for Fun*, issue 88, July 2012, pp. 5-8.

G. Hart, “Three Rubber Band Puzzles,” Presented at Gathering for Gardner 10.

G. Hart, “Bringing M.C. Escher's Planaria to Life,” *Proceedings of Bridges Towson,* Bosch et al. eds., pp. 57-64, 2012.

G. Hart, Forward to *Woodcarving Magic*, by Bjarne Jespersen, Fox Chapel Publ., 2012.

G. Hart, “Symmetric Stick Puzzles,” *Proceedings of Bridges 2011,* Coimbra Portugal, Carlo Sequan and Reza Sarhangi eds., pp. 357-364.

G. Hart, et al., “Forming a Museum of Mathematics,” *The Science Exhibition*, MuseumsEtc., 2010.

G. Hart, “How to slice a bagel into two linked halves,” *Annals of Improbable Research*, Vol. 16, no. 1, Jan-Feb, 2010, pp. 16-17.

G. Hart, “Prototypes in the Hands of a Mathematical Sculptor,” *Journal of Visual Communication,* 2010.

G. Hart, “An Algorithm for Constructing 3D Struts,” *Journal of Computer Science and Technology,* 24:1, 2009, pp. 56-64.

G. Hart, “Comet!” in *Hyperseeing: Proceedings of ISAMA 09*, pp. 95-102.

G. Hart, “Mutual Support” image on cover of *College Mathematics Journal*, Vol 40, No. 2, March 2009, with blurb inside front cover.

G. Hart, “Growth Forms,” in *Proceedings of Bridges 2009*, Banff, Alberta, Craig Kaplan and Reza Sarhangi eds., pp. 207-214.

G. Hart, “Make the Egg Heads Puzzle,” *Make Magazine*, vol. 17, Feb. 2009, pp. 143-145.

G. Hart, “Orderly Tangles Revisited,” in *Mathematical Wizardry for a Gardner*, ed. Ed Pegg Jr, Alan H. Schoen, and Tom Rodgers, A.K. Peters, 2009, pp. 187-210.

G. Hart, "Egg Heads: A Puzzle/Sculpture" in *Geometry, Games, Graphs, and Education: The Joe Malkevitch Festschrift*, ed. Sol Garfunkel and Rishi Nath, COMAP, 2008.

G. Hart, "FIRE", 28th *International Puzzle Party*, ed. Peter Hajek et al., 2008, p. 61.

G. Hart, "Two-Cent Wobbler," *Make Magazine*, Volume 15, Aug 2008, p. 136.

G. Hart, "Screw-Together Cube," *Gathering for Gardner G4G8* Exchange Book, 2008.

G. Hart, "Procedural Generation of Sculptural Forms," *Proceedings of Bridges 2008*, pp. 209-218.

G.W. Hart and Natasha Jonoska, "Knotting Mathematics and Art: Conference in Low Dimensional Topology and Mathematical Art," in *Journal of Mathematics and the Arts*, vol. 2, no. 1, March, 2008, pp. 47-51.

G. Hart, "Geometric Sculpture: A Survey of My Work," *Proceedings of Second International Science and Art Conference,* Athens Greece, 2008.

G. Hart, "Sculptural Forms from Hyperbolic Tessellations," Proceedings of *IEEE Shape Modeling International 2008*, pp. 155-161

G. Hart, "A Twenty-Part Puzzle," *Cubism for Fun*, issue 74, November, 2007.

G. Hart, "Sculptural Presentation of the Icosahedral Rotation Group," in *special issue of CRM-AMS Proceedings & Lecture Notes series, for the Groups and Symmetries Conference,* AMS publications, 2008, p. 211-214.

G. Hart, "Modular Kirigami," *Proceedings of Bridges Donostia*, San Sebastian Spain, 2007, pp. 1-8.

G. Hart, "Un Politopo pubblico a Venezia", in *Mathematica e Cultura 2007*, Michele Emmer editor, Springer-Verlag Italia, 2007, pp. 73-81.

G. Hart, " Barn Raisings of Four-Dimensional Polytope Projections," in Proceedings of International Society of Art, Math, and Architecture 2007, Texas A&M, May, 2007

G. Hart, "CD Sculpture Workshop" in Proceedings of International Society of Art, Math, and Architecture 2007, Texas A&M, May, 2007.

G. Hart, "Symmetric Sculpture", *Journal of Mathematics and the Arts*, v. 1, no. 1, pp 21-28, March, 2007.

G. Hart, "Sculpture Puzzles", Proceedings of *London Bridges: Mathematical Connections in Art, Music, and Science*, London, 2006.

G. Hart, "Mathematical Connections in Art", (Renaissance Banff conference report), *Math Horizons,* February 2006, p. 5 and inside front cover.

G. Hart, "Creating a Mathematical Museum on your Desk", *Mathematical Intelligencer*, 27, No. 4, Winter, 2005.

G. Hart, "The Geometric Aesthetic," Chapter 10 of *The Visual Mind II*, Michele Emmer (ed.), MIT Press, 2005.

G. Hart, "Orderly Tangles Revisited", Proceedings of *Bridges 2005: Mathematical Connections in Art, Music, and Science,* Banff, Alberta, 2005.

G. Hart, "Paper Polylinks", Proceedings of *Bridges 2005: Mathematical Connections in Art, Music, and Science*, Banff, Alberta, 2005.

G. Hart, "Spaghetti Code: A Sculpture Barnraising", Proceedings of *Art+Math=X* International Conference, University of Colorado, Boulder, June 2005, pp. 88-92.

G. Hart, "`Slide-Together' Geometric Paper Constructions", Teachers' workshop at *Bridges 2004*.

G. Hart, "A Reconstructible Geometric Sculpture", Proceedings of Intl. Soc. of Art, Math. And Architecture, CTI 2004, DePaul University, June 17-19, 2004, Stephen Luecking ed., pp. 141-143.

G. Hart, "A Salamander Sculpture Barn Raising", Proceedings of *Bridges 2004: Mathematical Connections in Art, Music, and Science*, Southwestern College, Winfield, Kansas, July 2004, reprinted in *Visual Mathematics* 7, no. 1, 2005.

G. Hart, "Sculpture from Symmetrically Arranged Planar Components", in *Meeting Alhambra*, (*Proceedings of ISAMA-Bridges 2003*, Granada, Spain), Javier Barrallo et al editors, Univ. of Granada, 2003, pp. 315-322.

G. Hart, "Conference Report: Bridges/ISAMA 2003", Nexus Network Journal, vol. 5 no. 2, Autumn 2003

G. Hart, "Mathematics Takes Shape," *Math Horizons*, April 2003, pp. 17-21.

G. Hart, "A Color-Matching Dissection of the Rhombic Enneacontahedron", *Symmetry: Culture and Science,* vol.11, 2000 (printed in 2003), pp. 183-199.

G. Hart "4D Polytope Projection Models by 3D Printing", to appear in *Hyperspace*.

Contributor to Chemical Rubber Company, *Standard Mathematical Tables and Formulae, 31st edition*, Daniel Zwillinger editor, Chapman & Hall, 2003.

Erik D. Demaine, David Eppstein, Jeff Erickson, George W. Hart, Joseph O'Rourke, "Vertex-Unfoldings of Simplicial Manifolds," ACM Symposium on Computational Geometry, June 5-7, 2002. Univ. Politècnica De Catalunya, Barcelona, Spain and in *Discrete Geometry: In Honor of W. Kuperberg's 60th Birthday*, 2002, Marcer Dekker Inc.

G. Hart, "In the Palm of Leonardo's Hand," *Nexus Network Journal*, vol. 4, no. 2, Spring 2002; reprinted in *Symmetry: Culture and Science,* vol. 11, 2000 (appeared in 2003), pp. 17-25. .

G. Hart, "Loopy," *Humanistic Mathematics*, June, 2002, pp. 3-5.

G. Hart, "Solid-Segment Sculptures," Colloquium on Math and Arts, Maubeuge, France, 20-22 Sept. 2000, and in *Mathematics and Art*, Claude Brute ed., Springer-Verlag, 2002.

G. Hart, "Rapid Prototyping of Geometric Models," Canadian Conference on Computational Geometry, University of Waterloo, August, 2001. (invited speaker)

Craig S. Kaplan and G. Hart, "Symmetrohedra: Polyhedra from Symmetric Placement of Regular Polygons," Proceedings of Bridges 2001: Mathematical Connections in Art, Music, and Science, Southwestern College, Winfield, Kansas, July 2001, pp. 21-29.

G. Hart, "Computational Geometry for Sculpture," Proceedings of ACM Symposium on Computational Geometry, Tufts University, June 2001, pp. 284-287. (invited speaker)

Douglas Zongker and G. Hart, "Blending Polyhedra with Overlays," Proceedings of Bridges 2001: Mathematical Connections in Art, Music, and Science, Southwestern College, Winfield, Kansas, July 2001, pp. 167-174.

G. Hart, "Sculpture based on Propellorized Polyhedra," Proceedings of MOSAIC 2000, Seattle, WA, August, 2000 and Proceedings of ISAMA 2000, Albany, NY, June 2000.

G. Hart, "The Millennium Bookball," Proceedings of Bridges 2000: Mathematical Connections in Art, Music and Science, Southwestern College, Winfield, Kansas, July 28-30, 2000, and in Visual Mathematics 2(3) 2000.

G. Hart, "Reticulated Geodesic Constructions," *Computers and Graphics* 24(6), Dec. 2000, pp. 907-910.

G. Hart, "Zonohedrification," *The Mathematica Journal*, vol. 7 no. 3, 1999.

G. Hart, "Computer Modeling and Construction of Geometrical Sculpture," invited talk at U.C. Berkeley, Feb. 1999.

G. Hart, "Geometric Sculpture," invited talk at Carpenter Center for the Visual Arts, Harvard University, Nov. 1998.

G. Hart, "Constructive Geometric Sculpture", invited talk at New York Academy of Sciences, Oct. 1998.

G. Hart, "Icosahedral Constructions," in Proceedings of *Bridges: Mathematical Connections in Art, Music and Science,* Southwestern College, Winfield, Kansas, July 28-30, 1998, pp. 195-202 (invited presentation).

G. Hart, *Polyhedra and Art,* Art and Math '98, U.C. Berkeley, August 3-7, 1998.

G. Hart, "Paper Prototype of a Geometric Sculpture: *Whoville*," (Invited workshop presentation) Art and Math '98, U.C. Berkeley, August 3-7, 1998.

G. Hart, "Zonish Polyhedra," Proceedings of *Mathematics and Design '98*, San Sebastian, Spain, June 1-4,1998.

G. Hart, "Calculating Canonical Polyhedra," *Mathematica in Research and Education,* Vol. 6 No. 3, Summer,1997, pp. 5-10.

G. Hart "Polyhedra Models over the Internet", MAA Mathfest, Atlanta GA, August, 1997.

G. Hart, "A Color-Matching Dissection of the Rhombic Enneacontahedron," Art and Math conference, S.U.N.Y. Albany, N.Y., June, 1997.

G. Hart, "Applications of Virtual Reality and Java for Illustrating Polyhedral Geometry over the Internet," Conf. on Electronic Communication of Mathematics, Geometry Center, U. Minn. June 1997.

G. Hart, "Virtual Reality Polyhedra," Art and Mathematics Conf., SUNY Albany, NY, June, 1996.

G. Hart, "Nonintrusive Appliance Load Monitoring," American Power Conference, Chicago IL, April, 1996.

G. Hart, "Dimensioned Linear Algebra — Physical Quantities and Computational Software," *Mathematica Conference for developers and users*, Champaign-Urbana, October 5-8, 1995.

I. Rouvellou and G. Hart, “Automatic Alarm Correlation for Fault Identification," INFOCOM, 1995.

V. Tsotras, B. Gopinath, and G. Hart, “Efficient Management of Time-Evolving Databases," *IEEE Transactions on Knowledge and Data Engineering,* August, 1995, pp. 591-608.

I. Rouvellou and G. Hart, “Inference of a Probabilistic Finite-State Machine from its Output," *IEEE Transactions on Systems Man and Cybernetics,* March, 1995, pp. 424-437.

V. Tsotras, B. Gopinath, and G. Hart, “The Effect of Universe Knowledge on Parallel Algorithms," *International Journal on Mini and Micro Computers,* 1995

G. Hart, “Three Approaches to Nonintrusive Monitoring of Continuously-Variable Loads," New Issues in End-Use Measurements Workshop, Vancouver, British Columbia, Oct. 1994.

G. Hart, “The Theory of Dimensioned Matrices," Proceedings of 5th SIAM Conference on Applied Linear Algebra, Snowbird, Utah, June 1994, pp. 186-190.

G. Hart and S. Kelekar, “Automated Repair of Complex Systems by Fault Compensation," *IEEE/ACM Transactions on Networking,* April, 1994, pp. 193-205.

G. Hart, “Automatic Construction of Finite-State Load Behavior Models," Proceedings of Fourth International Symposium on Distribution Automation and Demand-Side Management, Orlando, Florida, Jan. 18-19, 1994.

S.G. Kelekar and G. Hart, “Synthesis of Protocols and Protocol Converters Using the Submodule Construction Approach," 13th IFIP Symposium on Protocol Specification, Testing, and Verification, Liege, Belgium, May 25-28, 1993. Also in A. Danchine et. al. (eds.), *Protocol Specification, Testing, and Verification*, IFIP Transactions C-16, North Holland, pp. 307-322, 1993.

G. Hart, “To Decode Short Cryptograms," *Communications of the ACM,* Sept., 1994, pp. 102-108.

I. Rouvellou and G. Hart, “Probabilistic Finite-State Machine Inference: An Application to Alarm Correlation," ORSA Telecommunications Conf., Chicago, May 16-19, 1993.

A. Bouloutas, G. Hart, and M. Schwartz, “Fault Identification Using a Finite-State Machine Model with Unreliable Partially Observed Data Sequences," *IEEE Transactions on Communications*, July 1993, pp. 1074-1083.

J.F. Labourdette, G. Hart, and A. Acampora, “Branch-Exchange Sequences for Reconfiguration of Lightwave Networks," *IEEE Transactions on Communication,* October 1994, pp. 2822-2832.

I. Rouvellou and G. Hart, “Algorithm for Identification of Network Topology," IEEE Network Operations and Management Symposium, Memphis, Tenn., April 1992.

G. Hart and A. Bouloutas, “Correcting Dependent Errors in Sequences Generated by Finite-state Processes," *IEEE Transactions on Information Theory,* July 1993, pp. 1249-1260.

G. Hart, “Nonintrusive Appliance Load Monitoring," *IEEE Proceedings,* December 1992, pp. 1870-1891.

Labourdette, J., Acampora, A., and Hart, G., “Sequences of Branch Exchanges for Logical Reconfiguration of Lightwave Networks," Proceedings of Second ORSA Telecommunications Conf., March 9-11, 1992, Boca Raton, Florida.

Rouvellou, I. and Hart, G., “Topology Identification for Traffic Configuration Management in Dynamic Networks," Proceedings of Second ORSA Telecommunications Conf., March 9-11, 1992, Boca Raton, Florida.

Rouvellou, I. and Hart, G., “Inference of a Probabilistic FSM from its Outputs," Proceedings of Second ORSA Telecommunications Conf., March 9-11, 1992, Boca Raton, Florida.

J.F. Labourdette, A. Acampora, and G.W. Hart, “Reconfiguration Algorithms for Rearrangeable Lightwave Networks," INFOCOM, '92.

I. Rouvellou and G. Hart, “Topology Identification for Traffic and Configuration Management in Dynamic Networks," INFOCOM, 1992.

J.F. Labourdette and G. Hart, “Blocking Probabilities in Multitraffic Loss Systems: Insensitivity, Asymptotic Behavior, and Approximations," *IEEE Transactions on Communications,* August, 1992, pp. 1355-1366.

G. Hart, “The Theory of Dimensioned Matrices," Columbia University Center for Telecommunications Research Technical Report, 1991.

G. Hart, “Advances in Nonintrusive Appliance Load Monitoring," Proceedings of the EPRI 1991 Information and Automation Conference, Washington, D.C.

A. Bouloutas, G. Hart, and M. Schwartz, “Simple Finite-State Fault Detectors for Communication Networks," *IEEE Transactions on Communications,* March 1992, pp. 477-479.

R. Kannurpatti and G. Hart, “System Identification with Unknown Model Order," *IEEE Transactions on Information Theory,* September, 1991, pp. 1440-1450.

A. Bouloutas, G. Hart, and M. Schwartz, “Two Extensions of the Viterbi Algorithm," *IEEE Transactions on Information Theory,* March 1991, pp. 430-436.

V. Tsotras, B. Gopinath, and G. Hart, “Using Universe Knowledge and Arithmetic to Get Faster Parallel Algorithms," Proceedings of the 2nd IEEE Symposium on Parallel and Distributed Processing, (SPDP), December 1990, Dallas, Texas.

V. Tsotras, B. Gopinath, and G. Hart, “New Upper Bounds for Parallel Merging and Maximum Finding," in Proceedings of ISMM International Conf. on Parallel and Distributed Computers and Systems, New York, Oct. 10-12, 1990.

J.F. Labourdette and G. Hart, “Link Access Blocking in Very Large Multi-Media Networks," ACM SIGCOM '90, September 1990, Philadelphia, PA, and in *Computer Communications Review 20,* no. 4, Sept. 1990, pp. 108-111.

V. Tsotras, B. Gopinath, and G. Hart, “A New Bound on Parallel Searching," in Proceedings of the Fourth Parallel Processing Symposium, April 4-6, 1990, Fullerton, CA., pp. 613-622.

V. Tsotras, B. Gopinath, and G. Hart, “Optimally Managing the History of Evolving Forests," SIGAL, International Symposium on Algorithms, Tokyo, 1990, and in *Lecture Notes in ComputerScience,* #450, Springer-Verlag, 1990, pp. 468-478.

A. Bouloutas, G. Hart, and M. Schwartz, “On the Design of Observers for Fault Detection in Communication Networks," Chapter 5 of *Network Management and Control,* A Kershenbaum, M. Malek, and M. Wall, editors, Plenum Press, 1990.

A. Bouloutas, G. Hart, and M. Schwartz, “On the Design of Observers for Failure Detection of Discrete Event Systems," Network Management and Control Workshop, September 1989, New York.

Hart, G.W., “Residential Energy Monitoring and Computerized Surveillance via Utility Power Flows," *IEEE Technology & Society,* June 1989.

Hart, G.W. et al., Nonintrusive Appliance Load Monitor, U.S. patent #4,858,141.

Hart, G.W., “Identification of Multi-State Appliances," MIT Laboratory for Electromagnetic and Electronic Systems Technical Report, July 1987.

Hart, G.W., *Minimum Information Estimation of Structure,* MIT Ph.D. Dissertation, and MIT Laboratory for Information and Decision Systems Technical Report #1664, June 1987.

Hart, G.W. et al., Digital AC Monitor, U.S. patent #4,672,555.

Hart, G.W., “Nonintrusive Appliance Load Data Acquisition," in Proceedings: International Load Management Conference, Electric Power Research Institute Report #EM-4643, Section 40, June 1986.

EXHIBITIONS and PUBLIC ART

Sculpture exhibited at numerous exhibitions. Over 100 public artworks at schools and universities around the world. See `http://georgehart.com`

OTHER

President, Bridges Organization, running annual conference on mathematics and art. See `http://BridgesMathArt.org`

Editor for sculpture, *Journal of Mathematics and the Arts,* Taylor and Francis Publications.

Visiting Researcher, Fields Institute, Toronto, ON, Canada, 2016-2017.