

Curriculum Vitae

Name. Herbert Edelsbrunner

Rank. Professor

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Education

- Ph. D. in Technical Mathematics, Graz University of Technology, Austria, June 1982.
- M. S. in Technical Mathematics, Graz University of Technology, Austria, June 1980.

Main Appointments

- Professor, ISTA (Institute of Science and Technology Austria), Fall 2009–present.
- Founder, Director, and Principal, Geomagic, Inc., 1996–2013.
- Professor of Mathematics, Duke University, 2004–2012.
- Arts and Sciences Professor of Computer Science, Department of Computer Science, Duke University, 1999–2012.
- Professor, Department of Computer Science, University of Illinois at Urbana-Champaign, 1990–99.
- Associate Professor, Department of Computer Science, University of Illinois at Urbana-Champaign, 1987–90.
- Assistant Professor, Department of Computer Science, University of Illinois at Urbana-Champaign, 1985–87.
- Assistent, Institut für Informationsverarbeitung, Graz University of Technology, Austria, 1981–85.

Fields of Research

Computational topology, discrete and computational geometry, Data structures and algorithms, geometric modeling, mesh generation.

Honors and Awards

- Fellow of the European Association for Theoretical Computer Science, 2014.
- Corresponding and full member of the Austrian Academy of Science, 2012 and 2014.
- Member of the Academia Europaea, 2009.
- Member of the German Academy of Sciences (Deutsche Akademie der Wissenschaften, Leopoldina), 2008.
- Dean's Award for Excellence in Mentoring, 2007.
- Honorary Doctorate (Dr.h.c.) from the Graz University of Technology, 2006.
- Member of the American Academy of Arts and Sciences, 2005.
- Sir Edward Youde Memorial Fund Visiting Professorship 1999–2000, Spring 1999.
- Beckman Fellow in Center of Advanced Study, Fall 1997.
- Burlington Northern Faculty Achievement Award, 1992.
- Alan T. Waterman Award from the National Science Foundation, 1991.
- University Scholar Award from the University of Illinois Foundation, 1990.
- Senior Xerox Award for Faculty Research, 1989.

Grants

- Marie Curie, FP7-PEOPLE-2013-IEF, #622033, "Persistent homology – images, data and maps", 2014-2016.
- EC FP7-ICT-318493-STREP, "Topological complex systems", 2012-2015.
- Mega, 2011-220-01-252, "Discrete and computational geometry", 2011-2013.
- ESF Research Networking Programme, "Applied computational algebraic topology", 2011-2015.
- NSF DBI-08-20624. "GEPR: genome-wide analysis of root traits", 2008-2012.
- NIH, "Duke Center for Systems Biology", 2007–2012.
- NSF DBI-06-06873, "TRPGR: genomic approaches to identify genes for root system architecture traits", 2006–2008.

- CNRS PICS-3416, “Geometry and topology for complex shapes”, 2006–2008.
- DARPA HR0011-05-1-0057. “Microstates to macrodynamics: a new mathematics of biology”, 2005–2009.
- DARPA HR0011-05-1-0007. “Algebraic topological tools for high-dimensional data analysis”, 2005–2008.
- LLNL B543154. “Discrete methods for comparing continuous functions”, 2005–2006.
- NIH R01-GM61822-04S1. “Administrative supplement for the study of complex biological systems”, 2003–2005.
- LLNL B519702. “Mathematical work and algorithm development”, 2002.
- Duke University, BGT Postdoc Program, “Comput. geometry study of protein-protein interaction”, 2001–2004.
- NSF CCR-00-86013, “Computational geometry for structural biology and bioinformatics”, 2000–2005.
- NSF EIA-99-72879, “Data-intensive computing for spatial models”, 1999–2004.
- NSF-DARPA DMS-98-73945, “Simulation and computation of casting and extrusion processes”, 1998–2001.
- ARO DAAG55-98-0177, “Shape and surface reconstruction, quantification and deformation”, 1998–2002.
- DOE B341494. “Center for simulation of advanced rockets”, 1997–2002.
- DuPont educational aid program, 1997–98.
- NSF CCR-97-12088, “Computational geometry and biomolecular docking”, 1997–2002.
- NSF CCR-96-19542, “Deformable smooth surface and volume design”, 1997–2000.
- ONR N00014-95-1-0691, “Modeling with simplicial complexes”, 1995–97.
- General Motors Grant NA AFC773040, “GEOWRAP”, 1994–95.
- NSF ASC-94-04900, “Computation of shape and topology in proteins”, 1994–96.
- DEC alpha innovators equipment grant, “Planar and spatial geometric software”, 1993.
- NSF ASC-92-00301, “Shapes for modeling and visualization”, 1992–94.
- NSF CCR-91-18874, “Alan T. Waterman award”, 1991–95.
- NSF CCR-89-21421, “Triangulations in the plane and in space”, 1990–92.
- NSF CCR-87-14565, “Degeneracy in geometric computation”, 1988–90.
- Amoco. “Foundation for faculty development in Computer Science”, 1985–88.

Plenary Talks and Keynote Presentations

1. Shape, homology, persistence, and stability. 23rd International Symposium on Graph Drawing and Network Visualization, Los Angeles, California, September 24, 2015.
2. Shape, homology, persistence, and stability. Shape up – Exercises in Materials, Geometry, and Topology, Berlin, Germany, September 14, 2015.
3. Soft sphere packing. Geometry and Symmetry, dedicated to Karoly Bezdek and Egon Schulte on the occasion of their 60th birthdays, Veszprém, Hungary, June 29, 2015.
4. Multiple covers with balls. Intuitive Geometry, László Fejes Tóth Centennial, Budapest, Hungary, June 26, 2015.
5. Shape, homology, persistence and stability. AIMR International Symposium, Sendai, Japan, February 17, 2015.
6. Controlling topology by counting and measuring holes. 8th International Conference on Geographic Information Science, GIScience’14, Vienna, Austria, September 24, 2014.
7. Approximation and convergence of the first intrinsic volume. 5th International Workshop on Computational Topology in Image Context, CTIC’14, Timisoara, Romania, September 22, 2014.
8. The geometry and topology of data analysis. 3rd International Conference on Data Management Technologies and Applications, DATA’14, Vienna, Austria, August 31, 2014.
9. Shape, homology, persistence, and stability. 4th European Seminar on Computing, ESC’14, Pilsen, Czech Republic, June 16, 2014.
10. Shape, homology, persistence, and stability. 25th ACM-SIAM Symposium on Discrete Algorithms, SODA’14, Portland, Oregon, January 5, 2014.
11. Shape, homology, persistence, and stability. Jacobi 2013 Conference on High-performance Computing: Mathematical Models and Algorithms, Kaliningrad, Russia, October 3, 2013.
12. Shape, homology, persistence, and stability. Workshop on the Geometry and Physics of Spatial Random Systems, Freudenstadt, Germany, September 9, 2013.
13. Intrinsic volume relations and stabilized measures. Workshop on Geometry, Strobl, Austria, August 29, 2013.
14. Persistence for this and that. Workshop on the Analysis of Large-Scale, High-Dimensional, and Multivariate Data Using Topology and Statistics, Le Barp, France, June 12, 2013.

15. Persistent homology in image processing. 9th IAPR-TC-15 International Workshop on Graph-Based Representations in Pattern Recognition, Vienna, Austria, May 16, 2013.
16. Measuring with topology. 3rd Quantum Universe Symposium, QU3, Groningen, the Netherlands, March 27, 2013.
17. Stable length estimation for tube-like shapes. 17th IAPR International Conference on Discrete Geometry and Computer Imagery, Seville, Spain, March 20, 2013.
18. Persistent homology: theory and practice. 6th European Congress of Mathematics, Krakow, Poland, July 3, 2012.
19. From computational geometry to computational topology. 48th Dutch Mathematics Congress, Eindhoven, the Netherlands, April 12, 2012.
20. Point calculus for interlevel homology. 3rd International Workshop on Computational Topology in Image Context, CTIC'10, Cadiz, Spain, November 12, 2010.
21. The robustness of level sets. 18th European Symposium on Algorithms, ESA'10, Liverpool, United Kingdom, September 6, 2010.
22. Persistent homology under non-uniform error. 35th International Symposium on Mathematical Foundations of Computer Science, MFCS'10, Brno, Czech Republic, August 24, 2010.
23. Persistent homology applied. 7th International Conference on Curves and Surfaces, Avignon, France, June 28, 2010.
24. Computing persistence and robustness for images. Conference on Computational and Geometric Topology, Bertinoro, Italy, June 19, 2010.
25. Capturing shape with topology. Conference on Astronomical Data Analysis VI, Monastir, Tunisia, May 4, 2010.
26. Messen mit Algebra und Hartnäckigkeit. Deutsch-Österreichischer Mathematiker Kongreß, Graz, Austria, September 24, 2009.
27. Measuring with algebra. 2nd International Workshop on Computational Topology in Image Context. St. Katrein am Offenegg, Austria, August 27, 2009.
28. Measuring with persistent homology. Workshop on Topological Methods in Data Analysis and Visualization: Theory, Algorithms, and Applications. Snowbird, Utah, February 22, 2009.
29. An introduction to persistent homology. International Conference on Cyberworlds '07, Hannover, Germany, October 27, 2007.
30. An introduction to persistent homology. 6th International Congress on Industrial and Applied Mathematics, ICIAM 2007, Zürich, Switzerland, July 17, 2007.
31. An introduction to persistent homology. Symposium on Physical Solid Modeling, SPSM'07, Beijing, China, June 5, 2007.
32. A primer in topological persistence. Eurographics, Vienna, Austria, September 6, 2006.
33. Persistent homology, diagrams, and vineyards. AMS invited address, Annual Joint AMS-MAA Mathematics Meeting, San Antonio, Texas, January 14, 2006.
34. Computational geometry and topology. Workshop on Computational Topology, Summer Conference on Topology and Its Applications, Granville, Ohio, July 14, 2005.
35. Surface tiling with differential topology. Symposium on Geometry Processing, SGP'05, Vienna, Austria, July 4, 2005.
36. Computational algebraic topology. International Symposium on Recent Trends in Theoretical Computer Science, Kyoto, Japan, March 2, 2005.
37. Dynamic surface triangulation. An exercise in rational algorithm design. Conformal Geometry of Surfaces: Theory, Computation, Application, Townsend, Tennessee, May 18, 2003.
38. Dynamic surface triangulation. An exercise in rational algorithm design. 11th International Meshing Roundtable, Ithaca, New York, September 16, 2002.
39. Algorithms in combinatorial Morse theory. International Conference on Foundations of Computational Mathematics, FoCM'02, Minneapolis, Minnesota, August 9, 2002.

40. Bio-geometric modeling. Computational Challenges in the Post-Genomic Age-II, Durham, North Carolina, March 13, 2002.
41. Bio-geometric modeling. 9th Annual European Symposium on Algorithms, ESA'01, Aarhus, Denmark, August 30, 2001.
42. Mathematical problems in the (re-)construction of shape. Meeting of the American Mathematical Society, Columbia, South Carolina, March 16. 2001.
43. Hierarchical Morse complexes. NSF/DoE Lake Tahoe Workshop on Hierarchical Approximation and Geometrical Methods for Scientific Visualization, Tahoe City, California, October 15, 2000.
44. Concrete geometric modeling. Jahrestagung der Deutschen Mathematiker Vereinigung, Section Geometrie, Technische Universität Dresden, Germany, September 18, 2000.
45. The concrete approach to geometric modeling. 6th SIAM Conference on Geometric Design, Albuquerque, New Mexico, November 3, 1999.
46. Computational topology. 4th CGC Workshop on Computational Geometry, Baltimore, Maryland, October 16, 1999.
47. Computational geometry and discrete mathematics in CAD. SIAM Workshop Math. Found. CAD, Berkeley, California, June 5, 1999.
48. Shape space from deformation. 6th Pacific Conf. Comput. Graphics Appl., Singapore, October 29, 1998.
49. Shape space from deformation. 14th Annual Symposium on Computational Geometry, SoCG'98, Minneapolis, Minnesota, June 7, 1998.
50. Shape reconstruction from Delaunay complex. International Symposium Latin American Theoretical Informatics, LATIN'98, Campinas, Brazil, April 22, 1998.
51. Geometry for modeling biomolecules. 3rd International Workshop Algorithmic Foundations of Robotics, Houston, Texas, March 7, 1998.
52. Spielereien mit Kreisen. Beschreibung von Formen und Deformationen. Zur Kunst des Formalen Denkens, Graz, Austria, March 7, 1997.
53. Computational topology. AMS-IMS-SIAM Conference on Discrete and Computational Geometry: Ten Years Later, Mount Holyoke, Massachusetts, July 18, 1996.
54. Smooth surfaces for multi-scale shape representation. 12th European Workshop on Computational Geometry, Münster, Germany, March 28, 1996.
55. Smooth surfaces for multi-scale shape representation. 15th Conference on Foundations of Software Technology and Theoretical Computer Science, Bangalore, India, December 20, 1995.
56. Modeling with simplicial complexes (topology, geometry, and algorithms). 6th Canadian Conference on Computational Geometry, Saskatoon, Saskatchewan, August 2, 1994.
57. Modeling with simplicial complexes. Conference on Discrete and Computational Geometry, Budapest, Hungary, May 31, 1994.
58. Optimal triangulations by retriangulating. 2nd International Symposium on Algorithms, Taipei, Taiwan, December 17, 1991.
59. Results and problems on triangulations. 2nd Canadian Conference on Computational Geometry, Ottawa, Ontario, August 7, 1990.
60. Spatial triangulations and (dihedral) angle conditions. Workshop Discrete Algorithms and Complexity, Fukuoka, Japan, November 20, 1989.
61. Triangulierungen und Extremalaufgaben in der algorithmischen Geometrie. XII. Österreichischer Mathematikerkongress, Vienna, Austria, September 21, 1989.
62. Combinatorial and computational results for line arrangements in space. Workshop on Algorithms and Data Structures, WADS'89, Ottawa, Ontario, August 19, 1989.
63. Geometric structures in computational geometry. 15th Annual International Colloquium on Automata, Languages, and Programming, ICALP'88, Tampere, Finland, July 15, 1988.
64. Key-problems and key-methods in computational geometry. 1st Annual Symposium on Theoretical Aspects of Computer Science, STACS'84, Paris, France, April 11, 1984.

Lectures

1. Approximation and convergence of the first intrinsic volume. FrankFest, Williams College, Williamstown, Massachusetts, February 6, 2016.
2. Approximation and convergence of the first intrinsic volume. Ohio State University, Columbus, Ohio, September 2, 2014.
3. Persistent homology applied. College de France, Paris, France, December 6, 2012.
4. Application-inspired research in discrete and computational geometry. Yaroslavl State University, Yaroslavl, Russia, December 14, 2011.
5. Persistent homology for images. Academia Sinica, Institute of Information Science, Taipei, Taiwan, January 10, 2011.
6. Persistent homology. Applied Mathematics and Computational Science, University of Pennsylvania, Philadelphia, Pennsylvania, February 18, 2010.
7. Measuring scale before simplification. Distinguished Lectures in Computer Science, Columbia University, New York, November 11, 2008.
8. Measuring with persistent homology. Applied Mathematics and Computational Science Kickoff Symposium, University of Pennsylvania, Philadelphia, Pennsylvania, September, 27, 2008.
9. Measuring scale before simplification. BMS Friday Colloquium, Berlin Mathematical School, Berlin, Germany, October 26, 2007.
10. Biology and topology. RPI Computer Science Day, Rensselaer Polytechnic, Troy, New York, October 20, 2006.
11. Global methods for high-dimensional datasets. MillerFest, Carnegie Mellon University, Pittsburgh, Pennsylvania, April 20, 2006.
12. Interface surfaces of molecular complexes. Lorentz Center Highlights in the series This Week's Discoveries, Leiden University, the Netherlands, March 7, 2006.
13. Protein docking with elevation. Distinguished Lecture Series, Erik Jonsson School of Engineering and Computer Science, University of Texas at Dallas, Richardson, Texas, March 25, 2005.
14. Differential topology and combinatorial algorithms, and where this unlikely marriage works. Broad Area Colloquium For AI-Geometry-Graphics-Robotics-Vision, Stanford University, Stanford, California, May 3, 2004.
15. Bio-geometric modeling. Distinguished Lecture Series, Computer Science Department, State University of New York, Stony Brook, March 10, 2004.
16. PL implementations of differential topology concepts and their applications. MSRI-Evans talk, Workshop on the Mathematical Foundations of Geometric Algorithms, Mathematics Department, University of California at Berkeley, October 13, 2003.
17. Bio-geometric modeling. Distinguished Lecture Series, Computer Science Department, University of California at Santa Barbara, April 21, 2003.
18. Bio-geometric modeling. The Shape of Life Seminar, Carnegie-Mellon University, February 7, 2003.
19. Bio-geometric modeling. Paul M. Chung Distinguished Lecture Series, University of Illinois at Chicago, Illinois, November 11, 2002.
20. Bio-geometric modeling. Cray Distinguished Lecture Series, University of Minnesota, Minneapolis, April 1, 2002.
21. A historical perspective of arrangements. Sharir Fest, Hong Kong University of Science and Technology, Hong Kong, China, May 11, 2000.
22. Mathematical problems in the (re)construction of shapes. Mathematical Sciences Research Institute, Academic Sponsor's Day, March 3, 2000.
23. From theory to commercialization. Sir Edward Youde Memorial Lecture, Hong Kong Univ. Sci. Techn., Hong Kong, May 10, 1999.
24. Geometry for modeling biomolecules. Schwerpunktprogramm Effiziente Algorithmen für diskrete Probleme und ihre Anwendung, St. Augustin, Germany, July 2, 1997.
25. Circles and triangles. Modeling shape and deformation. Marden lecture at University of Wisconsin at Milwaukee, Milwaukee, Wisconsin, April 25, 1997.

26. Something general and something less general on geometric algorithms. Computer Research Association Meeting, Snowbird, Utah, July 12, 1992.

Advising

Postdoctoral Advisees

- Grzegorz Jablonski: Sampled dynamical systems, 2016–present.
- Ziga Virk: Topology and applications, 2015–present.
- Mirko Klukas: Topology, learning, and art, 2015–present.
- Hubert Wagner: Topological data analysis in high dimensions, 2015–present.
- Arseniy Akopyan: Discrete and classical geometry, 2015–present.
- Salman Parsa: Fast data structures for topology, 2014–2015.
- Pawel Pilarczyk: Persistence for dynamical systems, 2014–present.
- Stefan Huber: Medial structures in geometry and topology, 2013–15.
- Jan Reininghaus: Computational topology in visualization, 2012–14.
- Ulrich Bauer: Simplification in computational topology, 2012–14.
- Olga Symonova: Applied topology in image processing, 2011–15.
- Amit Patel: Algebra and algorithms for well groups, 2010.
- Michael Kerber: Algorithms in algebraic geometry and topology, 2009–12.
- Paul Bendich: Computational algebraic topology, 2009–10.
- Chao Chen: Computational topology and computer vision, 2009–12.
- Yuriy Mileyko: Computational topology and biology applications, 2005–08.
- David Cohen-Steiner: Computational algebraic topology, 2003–04.
- Vicky Choi: Computational structural biology, 2002–04.
- Alper Üngör: Mesh generation, 2002–04.
- Sergei Bespamyatnikh: Protein-protein interaction, 2001–02.
- Jie Liang: Biomolecular modeling and computation, 1993–96.
- Ernst P. Mücke: Alpha shapes, 1993–94.
- Tamal R. Dey: Discrete geometry, 1991–92.

Current Ph. D. Students

- Zuzane Masárová: Geometric drawing and visualization.
- Anton Nikitenko: Geometric measures, percolation, and persistence.
- Mabel Iglesias-Ham: 3D packing and reconstruction problems with applications in biology.

Completed Ph. D. Students

- Florian Pausinger 2015: On the approximation of intrinsic volumes.
- Salman Parsa, 2014: Algorithms for the Reeb graph and related concepts.
- Brittany Fasy, 2012: Modes of Gaussian mixtures and an inequality for the distance between curves in space.
- Ying Zheng, 2012: Shape reconstruction with topological priors.
- Bei Wang, 2010: Separating features from noise with persistence and statistics.
- Amit Patel, 2010: Reeb spaces and the robustness of preimages.
- Dmitriy Morozov, 2008: Homological illusions of persistence and stability.
- Andrew Ban, 2005 (co-adv. J. Rudolph): Protein-protein interfaces and protein packing.
- Vijay Natarajan, 2004: Topological analysis of scalar functions for scientific visualization.
- Yusu Wang (co-adv. P. Agarwal), 2004: Geometric and topological methods in protein structure analysis.
- Ho-Lun Cheng, 2001: Algorithms for smooth and deformable surfaces in 3D.
- Afra Zomorodian, 2001: Computing and comprehending topology: persistence and hierarchical Morse complexes.
- Damrong Guoy, 2001: Tetrahedral mesh improvement, algorithms and experiments.
- Ulrike Axen, 1998: Discrete topology, sound, and virtual reality.
- Michael A. Facello, 1996: Geometric techniques for molecular shape analysis.
- Roman Waupotitsch, 1996: Simplifying and deforming through hierarchies of simplicial grids.
- Patrick J. Moran, 1996: Visualization and modeling with shapes.
- Nataraj Akkiraju, 1996: Molecule surface triangulation from alpha shapes.
- Edgar Ramos, 1995: Results in combinatorial and computational geometry.
- Nimish R. Shah, 1994: Topological modeling with simplicial complexes.
- Ernst P. Mücke, 1993: Shapes and implementation in three-dimensional geometry.

- Tiow Seng Tan, 1992: Optimal two-dimensional triangulations.
- Peter L. Williams (co-adv. D. Gannon), 1992: Interactive direct volume rendering of unstructured data.
- Harald Rosenberger, 1990: Degeneracy control in geometric programming.
- Xiaojun Shen (co-adv. C. L. Liu, E. Reingold), 1989: Combinatorics, computational geometry and search algorithms.
- Steven S. Skiena, 1988: Geometric probing.
- Franz Aurenhammer (co-adv. H. Maurer), 1984: Gewichtete Voronoi Diagramme.