2010 Robbins Prize

ILEANA STREINU received the David P. Robbins Prize at the 116th Annual Meeting of the AMS in San Francisco in January 2010.

Citation

The 2010 David P. Robbins Prize is awarded to Ileana Streinu of Smith College for her paper "Pseudo-triangulations, rigidity and motion planning", *Discrete Comput. Geom.* **34** (2005), no. 4, 587–635.

Ileana Streinu

In this remarkable work Streinu gives a combinatorial, algorithmic proof of the notorious "carpenter's rule problem", which asks whether any polygonal chain in the plane can be continuously straightened out. In such a process the edges are taken as rigid, but the vertices are joints; of course, no crossings are allowed at any time.

Streinu's proof is independent of, and quite different from, the earlier published differential proof of R. Connelly, E. D. Demaine, and G. Rote ("Straightening polygonal arcs and convexifying polygonal cycles", *Discrete Comput. Geom.* **30** (2003), no. 2, 205–239). This deservedly celebrated paper and Streinu's paper both do, however, arise in part from the idea of Rote's that a polygon could be convexified by motions which cause points on the perimeter to move away from one another.

The idea for Streinu's proof came from her careful examination of computer experiments in which the basic feasible solutions to convexification problems were coded as graphs. Further experimentation (using Mathematica®) allowed Streinu to identify patterns in these graphs and eventually to connect them with pseudo-triangulations and ideas from rigidity theory. The ultimate result was an explicit, efficient, and discrete algorithm for the carpenter's rule problem and a beautiful and highly original paper.

Biographical Sketch

Ileana Streinu received a Ph.D. in computer science from Rutgers University and a doctorate in mathematics from the University of Bucharest, Romania, both in 1994. Since then, she has taught at Smith College in Massachusetts, where she is the Charles N. Clark Professor of Computer Science and Mathematics, and at the University of Massachusetts, Amherst, where she holds a 2008–2011 Five Colleges 40th Anniversary Professor appointment. She had visiting positions at the Technical University in Berlin, Ecole Normale Supérieure in Paris, Stanford University, Kyoto University, LORIA Nancy, and Universitat Politecnica de Catalunya in Barcelona, and she is a recipient of the 2004 Moisil Award of the Romanian Academy in theoretical computer science.

Streinu's mathematical interests include discrete and computational geometry, rigidity theory, kinematics, matroids, and graph theory. Her recent work extends in multidisciplinary directions, ranging from robotics and origami to the emerging fields of bio- and nanogeometry, in which she is pursuing mathematical questions arising in studies of flexibility, rigidity, and motions for macromolecules.

Response

It is a great honor to receive the Robbins Prize acknowledging my algorithmic solution to the carpenter's rule problem.

Through its simple statement, the problem exercised a fascination on all who encountered it. I learned about it from Sue Whitesides, who brought it up at a problem-solving workshop she organized in 1998. When, in 1999, at a Discrete Geometry meeting in Switzerland, Günter Rote proposed the use of expansive motions, he also suggested a proof plan that contained most of the ingredients of what was to become the celebrated Connelly, Demaine, and Rote proof of the carpenter's rule

theorem. This connection with rigidity theory and Maxwell's theory of lifted polyhedra marked a turning point in my research interests. I am grateful to all the colleagues who worked on this problem for the inspiration and the challenges they generated, which caused me to look deeper and in different directions. The emergence of pseudo-triangulations, with their clean combinatorics and unexpected rigidity properties, was a rewarding surprise. I am convinced that so much more about them, and their three-dimensional relatives, still remains to be discovered.

I am deeply grateful to the selection committee and the AMS for having awarded me this distinction, and to my family, friends, and collaborators (especially to Ciprian S. Borcea, who is all of these) for their support.

Funding by NSF and by DARPA's "Mathematical Challenges", generous support from Smith College and UMass Amherst, and sabbatical visiting positions have enabled periods of extended, uninterrupted "thinking time" that are so important for any mathematical work.

About the Prize

The Robbins Prize was established in 2005 in memory of David P. Robbins by members of his family. Robbins, who died in 2003, received his Ph.D. in 1970 from the Massachusetts Institute of Technology. He was a long-time member of the Institute for Defense Analysis Center for Communications Research and a prolific mathematician whose work (much of it classified) was in discrete mathematics.

The prize is given for a paper that (1) reports on novel research in algebra, combinatorics, or discrete mathematics, (2) has a significant experimental component, (3) is on a topic broadly accessible, and (4) provides a simple statement of the problem and clear exposition of the work. The US$5,000 prize is awarded every three years.

The Robbins Prize is awarded by the AMS Council acting on the recommendation of a selection committee. For the 2010 prize, the members of the selection committee were: Louis J. Billera, Carol E. Fan, David J. Saltman, John R. Stembridge, and Peter M. Winkler (chair).

The previous recipients of the Robbins Prize are Samuel Ferguson and Thomas C. Hales (2007).