ELLIOT ANSHELEVICH

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Research Interests

My interests center on the design and analysis of algorithms. I am especially interested in algorithms for large decentralized networks, including networks involving strategic agents. In particular, I am interested in:

- Strategic agents in networks, and influencing their behavior
- Network design problems
- Distributed load balancing algorithms
- Local and decentralized routing algorithms
- Influence and information propagation in both social and computer networks

Education

Cornell University, Ithaca, New York, 2000-2005
Ph.D. Computer Science, expected May 2005
Thesis title: Design and Management of Networks with Strategic Agents
Advisor: Jon Kleinberg
Master of Science, May 2004

Rice University, Houston, Texas, 1996-2000
B.S. Computer Science, May 2000
Double major in Computer Science and Mathematics
magna cum laude

Professional and Research Experience

Lucent Technologies, Murray Hill, New Jersey — Summer 2004
Conducted research on game theoretic network design with Gordon Wilfong and Bruce Shepherd. We study the peering and customer-provider relationships between Autonomous Systems in the Internet, and analyze them using algorithmic game theory. This research is still ongoing and we expect to submit our results for publication in Spring 2005.

Lucent Technologies, Murray Hill, New Jersey — Summer 2003
Conducted research as an intern on optical network design at Bell Labs. This research was done together with Lisa Zhang. We addressed the problem of designing a cheap optical network that satisfies all user demands. What makes this network design problem novel is the unusual cost function particular to this type of optical networks. Our results can be found in a paper titled "Path Decomposition under a New Cost Measure with Applications to Optical Network Design" authored by Elliot Anshelevich and Lisa Zhang, published at ESA 2004.

Cornell University, Ithaca, New York 2000-2005
As a graduate student, I worked on a variety of research problems, and with a variety of people such as David Kempe, Jon Kleinberg, Tim Roughgarden, and Eva Tardos. Some results can be found in my publications listed below. Other than published results, I have also performed some research in the analysis of BGP stability, and influence propagation in social networks.

Bluware Corporation, Houston, Texas Summer 2000
Worked as a programmer, mostly on the creation of a large dynamically-generated website with a database interface. Used a lot of Java, SQL, Javascript, and Applet programming.

Rice University: Computer Science Department 1999 - 2000
Robotics research on motion planning for deformable volumes. This project was supervised by Florent Lamiraux and Prof. Lydia Kavraki. Results can be found in a paper titled "Deformable Volumes in Path Planning Applications" authored by Elliot Anshelevich, Scott Owens, Florent Lamiraux, and Lydia Kavraki, published at ICRA 2000.

Rice University: Computer Science Departement Summer 1998
Researched Java compilation for Ken Kennedy and Zoran Budimlic. Merged two Java optimizing compilers and implemented several inlining features.

Rice University: Mathematics Department Summer 1997
Implemented a Java graphics applet with a full graphical user interface for Prof. Polking. The purpose of this applet was to facilitate the teaching of mathematics to high school and undergraduate students. It performed illustrations of Non-Euclidean geometry through user interactions.

Annotated Publications

- Elliot Anshelevich, Anirban Dasgupta, Jon Kleinberg, Eva Tardos, Tom Wexler, and Tim Roughgarden. "The Price of Stability for Network Design with Fair Cost Allocation." In *Proc. 45th Annual IEEE Symposium on Foundations of Computer Science* (FOCS 2004).

  We study the ratio of the best Nash equilibrium with the centralized optimum (the price of stability) in a network design context where independent agents wish to connect certain nodes. The best Nash equilibirum solution has a natural meaning of stability in this context – it is the optimal solution that can be proposed from which no user will "defect". We show that if the edge cost allocation is done using a Shapley value fair division scheme, then the price of stability is at most O(log k), where k is the number of agents, and that a good Nash equilibrium can be achieved via best-response dynamics. We also extend our results to many more general models, such as the case where the network has latencies.

- Elliot Anshelevich and Lisa Zhang. "Path Decomposition under a New Cost Measure with Applications to Optical Network Design." In *Proc. 12th Annual European Symposium on Algorithms* (ESA 2004).

We consider a network design problem with a novel yet simple cost function. The underlying network must be partitioned into disjoint paths, and the cost of a connection is the number of these paths that the connection path intersects. We give a 2-approximation algorithm in the case that the connection routes are fixed, and show an optimal algorithm for that case with maximal network degree 3. For the case where both the path partition and the connection paths must be optimized, we give a log-approximation in the general case and a 3/2-approximation for the ring topology.

- Elliot Anshelevich, Anirban Dasgupta, Eva Tardos, and Tom Wexler. "Near-Optimal Network Design with Selfish Agents." In *Proc. 35th ACM Symposium on Theory of Computing*, (STOC 2003).

  We study a simple network design game that models how independent selfish agents can build or maintain a large network. We show that in a restricted context where each connection shares a common source, we can force these agents into a stable solution which is no worse than the centralized optimum. We also demonstrate that in a more general context, there is always an approximately stable solution which is no worse than the centralized optimum. Finally, we give poly-time algorithms to find these solutions.

- Elliot Anshelevich, David Kempe, and Jon Kleinberg. "Stability of Load Balancing Algorithms in Dynamic Adversarial Systems. In *Proc. 34th ACM Symposium on Theory of Computing*, (STOC 2002).

  We study the load balancing and packet routing problems in a dynamic online setting, where an adversary can insert and remove jobs or packets. We give proofs of stability for a natural distributed algorithm against rate-1 adversaries, for load balancing with up to 2 commodities, and packet routing with a single sink. A major contribution of this paper is a new technique for stability proofs.

- Elliot Anshelevich, Scott Owens, Florent Lamiraux, and Lydia Kavraki. "Deformable Volumes in Path Planning Applications." In *Proc. IEEE International Conference on Robotics and Automation 2000*, 2290-2295.

  We use the framework of the PRM (Probabilistic Roadmap Planner) to tackle the problem of path planning for deformable volumes. The underlying geometric model for the volume is provided by a mass-spring representation, augmented with a realistic mechanical model. We present experimental results that illustrate our path planning approach.

Invited Talks and Talks in Conferences

University of Minnesota Computer Science Colloquium. "The Price of Stability in Network Design." Twin Cities, Minnesota, April 2005.

Rensselaer Polytechnic Institute Computer Science Colloquium. "The Price of Stability in Network Design." Troy, New York, April 2005.

Northwestern University Computer Science Lecture Series. "The Price of Stability in Network Design." Evanston, Illinois, March 2005.

DIMACS Theoretical Computer Science Seminar. "The Price of Stability for Network Design." New Brunswick, New Jersey, November 2004.

European Symposium on Algorithms, 2004. "Path Decomposition Under a New Cost Measure with Applications to Optical Network Design." Bergen, Norway, September 2004.

IBM Watson Mathematics Seminar. "The Price of Stability for Network Design." Yorktown Heights, New York, August 2004.

1st Bertinoro Workshop on Algorithmic Game Theory (AGATE 2004). "The Price of Stability for Network Design with Fair Cost Allocation." Bertinoro, Italy, June 2004.

Bell Labs Computing Sciences Research Seminar. "Near-Optimal Network Design with Selfish Agents." Murray Hill, New Jersey, June 2003.

ACM Symposium on Theory of Computing, 2003. "Near-Optimal Network Design with Selfish Agents." San Diego, California, June 2003.

ACM Symposium on Theory of Computing, 2002. "Stability of Load Balancing Algorithms in Dynamic Adversarial Systems". Montréal, Québec, Canada, May 2002.

Professional Activities

Served as Desk Czar, Department of Computer Science, Cornell University, 2002-2004. Was responsible for assigning offices and office-mates for graduate students.

Organized the Theory Discussion Group, Department of Computer Science, Cornell University, 2002.

Served as a Mentor in the Cornell Department of Computer Science First-year Mentorship program, 2001-2003.

Referee: SIAM Journal of Computing, 2003; FOCS 2004; Networks 2004; Special Issue of Algorithmica on Network Design; SODA 2005; STACS 2005; IPCO 2005.

Honors and Awards

Teaching Assistant Award for Excellence, given by the Cornell Department of Computer Science, Spring 2004

National Science Foundation Graduate Fellowship, 2000-2003

Louis J. Walsh Scholarship in Engineering 1999

Rice University Moody Merit Scholarship in Engineering 1998

Citizenship Status

U.S. Citizen

References

Available upon request