The Supernetwork Sentinel

The Newsletter of the Virtual Center for Supernetworks

Summer 2004

Welcome to the Summer 2004 edition of ***The Supernetwork Sentinel***, the newsletter of the Virtual Center for Supernetworks at the Isenberg School of Management, UMass-Amherst. ***The Supernetwork Sentinel*** is published in Fall, Winter, and Summer editions. Its purpose is to keep you informed of events, activities, and successes of the Virtual Center for Supernetworks and the Supernetwork Laboratory for Computation and Visualization. In this newsletter, we include news items, noteworthy recognitions, an essay on the research team residency of Nagurney, Daniele, and Cojocaru at the Rockefeller Foundation's Bellagio Center in Italy, and information regarding center activities.

Anna Nagurney
John F. Smith Memorial Professor
Director – Virtual Center for Supernetworks

Welcome New International Associates!

It is with great pleasure that the Center Director welcomes new International Center Associates, Professor Monica Cojocaru of the Department of Mathematics and Statistics at the University of Guelph, Canada, and Professor Patrizia Daniele of the Department of Mathematics and Computer Science at the University of Catania in Italy (see the newsletter essay which also appeared in OR/MS Today, April 2004).

Professors Daniele, Nagurney, and Cojocaru at the Rockefeller Foundation's Bellagio Center in Italy

Press coverage of the Bellagio team residency has appeared in the US, in Canada, and in Italy.

For more photos of and information on the Center see: http://supernet.som.umass.edu

Center in the Media

The Virtual Center for Supernetworks and its research on critical infrastructure networks and electric power network modeling were the cover story in the Winter 2004 issue of the *Commonwealth* published by the Isenberg School of Management.

Stephen Davis receives Leaders for the 21st Century Award from Chancellor Lombardi: http://www.umass.edu/commencement/2004/leaders.html Coverage in the *Springfield Republican* and the *Daily Hampshire Gazette* in May 2004.

Jose Cruz was the subject of a first page story in the *Daily Hampshire Gazette* on May 22, 2004.

Professor Anna Nagurney has signed on with the INFORMS Speaker's Bureau; see the link: http://www.informs.org/Speakers/bios/Nagurney.htm

Inside

Essay
Experiences from a Research Team Residency at the Rockefeller Foundation's Bellagio Center

Anna Nagurney, Patrizia Daniele, and Monica Gabriela Cojocaru

From March 10-23, 2004, we were in residence at the Rockefeller Foundation's Bellagio Study and Conference Center located in Bellagio on Lake Como in northern Italy. The Bellagio Center opened in 1959 to allow scholars, scientists, artists, writers, as well as policy-makers and practitioners from around the globe to pursue their research and creative work. Its setting is idyllic with views of Lake Como and the Alps, coupled with magnificent gardens and parks. The beauty of the setting, the support that we received, the rewarding interactions with other scholars outside our disciplines and the musicians, artists, and writers that were in residence during our stay, provided us with a truly unique and exceptional environment in which to pursue our research project.

The title of our team project was: "Dynamics of Complex Networks in an Environment of Risk and Uncertainty: Theoretical Foundations and Applications to Global Supply Chains and International Financial Networks." We were only the 152nd research team in the Center's history since research teams were instituted at the Center in the late 1990s. Our proposal had been submitted over a year earlier in response to a letter of invitation that Anna Nagurney received following her Distinguished Chaired Fulbright in Innsbruck, Austria in Spring 2002.

The research team consisted of Patrizia Daniele, Monica Gabriela Cojocaru, and Anna Nagurney. Patrizia Daniele was born in Sicily and received her Bachelor's degree at the University of Catania and her doctorate in Applied Mathematics and Computer Science from the University of Naples in 2000. In 1996, she was awarded the Gioacchino Iapichino Award by President Oscar Luigi Scalfaro of Italy, after a national competition, for one of her papers on variational inequalities (cf. Daniele (1994)). Patrizia is an Associate Professor of Operational Research at the University of Catania.

Monica Cojocaru was born in Romania and received her Bachelor's and Master's degrees in Mathematics at the University of Bucharest. She received her doctorate in Mathematics from Queen's University in Kingston, Canada in 2002 and was an NSERC postdoctoral fellow at the Centre des Recherches Mathematiques in Montreal. In 2003, Monica won the NSERC University Faculty Award competition for the Assistant Professor position that she presently holds at the University of Guelph.

Anna Nagurney is the John F. Smith Memorial Professor at the University of Massachusetts. She received her doctorate in Applied Mathematics with a specialty in Operations Research from Brown University. Among the awards that she has received are: the Kempe Prize from the University of Umea, Sweden, an NSF Visiting Professorship for Women and a Faculty Award for Women, an Eisenhower Faculty Fellowship, and two AT&T Industrial Ecology Fellowships.

The three research team members were greeted at the Milan airport on March 10 and were driven to the Bellagio Center (an approximately 2 hour drive). While at Bellagio, we stayed at our own minivilla, which was set up for our use and provided us with access to laptops, Internet connections, as well as a white board and printer. Our research interests and backgrounds created an incredible synergy from which we could conduct our research project. Although we had interacted through email, only Patrizia and Anna had ever met face to face, but we knew each other through our research interests and publications. Monica Cojocaru was the "purest" mathematician/operations researcher in the group. She had established results critical to the success of the project in her thesis and subsequent publications (see Cojocaru (2002) and Cojocaru and Jonker (2003)). In particular, she had generalized some of the results of Dupuis and Nagurney (1993) (see also Nagurney and Zhang (1996)) in projected dynamical systems to Hilbert spaces. Patrizia Daniele, in turn, had been working on evolutionary variational inequalities. She had developed time-dependent analogues of some of the traffic network, spatial price equilibrium, and financial equilibrium models (cf. Daniele, Maugeri, and Oettli (1998), Daniele (2002, 2003)) that Nagurney had formulated and studied (with students and co-authors) as finite-dimensional variational inequality problems (see Nagurney (1993, 2000), Nagurney and Siokos (1997), and the references therein).

From the first day of our residency, we established a rhythm that enabled us to work intensively from early in the morning until very late at night. In addition, we took part in some incredible and very memorable intellectual conversations and discussions during the meals as well as the evening seminars. For the most part, we worked together in the conference

room of our villa, brainstorming, questioning, connecting, researching the existing literature, marking up the white board with equations and diagrams, and establishing our results. Our primary goal was to build the theoretical foundations through the connections (and unification) of projected dynamical systems and evolutionary variational inequalities on Hilbert spaces. From the former, we could then gain powerful computational procedures, whereas from the latter we could gain a new richness in terms of model development and analysis in such fields as economics, operations research/management science, finance, as well as engineering (notably, transportation science), and environmental sciences, even with policy implications. The theoretical results that we obtained while at the Bellagio Center, the applications that can now be explored include some that can be interpreted in a new way, as well as entirely new and very exciting ones (notably, to global supply chain networks and international financial networks) will be written up in a series of papers.

When the intensity of our research and work necessitated a respite, we would take some time for a meal, a walk, or a song; laughter would soon follow. We got to share with artists, musicians, writers, human rights activists, public health experts, and historians what we consider to be the beauty of mathematics, its relevance, and its special nature in terms of research, creativity, and scientific discovery. We found that many of the residents eagerly anticipated our seminar presentation which was unique not only since it was being presented by three females but by three female mathematicians.

Our presentation took place on Friday night, March 19. We discussed the context of our work, with Anna providing the background and foundations, and focusing on a spectrum of network-based applications that had been studied as finite-dimensional variational inequality problems and as projected dynamical systems. Some applications that were described included supply chain networks, international financial networks with intermediation as well as recycling networks (for relevant papers, see: http://supernet.som.umass.edu). Patrizia followed with an overview of her modeling work on time-dependent spatial price and financial network models using evolutionary variational inequalities, coupled with her contributions to the existence and uniqueness of the solutions. Monica provided not only a discussion of infinite-dimensional projected dynamical systems but even showed dynamic trajectories using MAPLE. She also discussed why math is important, what is special about math, and listed some of the unsolved problems dating to the 19th century. The three of us also summarized the work that we had accomplished during the residency and highlighted the impact that it might have.

The research team residency was an experience of a life-time. It demonstrated the rewards of a sustained collaboration in an environment of great beauty and without the obligations of daily life. It was a privilege to be able to partake in the activities of the Bellagio Center during our two week tenure and we hope to return to our disciplines what we learned and discovered. Finally, we hope that we helped to get across the idea that operations researchers can be very dynamic, social, and engaging individuals, with interests that transcend different areas.

For background on the Rockefeller Foundation's Bellagio Center Program, see:
http://www.rockfound.org

Acknowledgments

We are deeply grateful to the Rockefeller Foundation's Bellagio Center program and to its staff for giving us this incredible opportunity.

References

Cojocaru, M. G., **Projected Dynamical Systems on Hilbert Spaces**, Ph. D. Thesis, Queen's University, Kingston, Ontario, Canada (2002).

Cojocaru, M. G. and Jonker, L. B*., Existence of Solutions to Projected Differential Equations in Hilbert Spaces,* Proc. Amer. Math Soc. 132 (2004), 183-193, online May 2003.

Daniele, P*., Dual Variational Inequality and Applications to Asymmetric Traffic Equilibrium Problem with Capacity Constraints,* Le Matematiche 49 –Fasc. II (1994), 211-222.

Daniele, P., *Time-Dependent Spatial Price Equilibrium Problem: Existence and Stability Results for the Quantity Formulation Model,* to appear in Journal of Global Optimization (2002).

Daniele, P., *Evolutionary Variational Inequalities and Economic Models for Demand Supply Markets,*M3AS: Mathematical Models and Methods in Applied Sciences 4 (13) (2003), 471-489.

Daniele, P., Maugeri, A. and Oettli, W., Time-Dependent Variational Inequalities, Journal of Optimization Theory and its Applications 103 (1999), 543-555.

Dupuis, P. and Nagurney, A, *Dynamical Systems and Variational Inequalities,* Annals of Operations Research 44 (1993), 9-42.

Nagurney, A., **Network Economics: A Variational Inequality Approach**, Kluwer Academic Publishers, Dordrecht, The Netherlands (1993).

Nagurney, A., **Sustainable Transportation Networks**, Edward Elgar Publishing, Cheltenham, England (2000).

Nagurney, A. and Siokos, S., **Financial Networks: Statics and Dynamics**, Springer-Verlag, Heidelberg, Germany (1997).

Nagurney, A. and Zhang, D., **Projected Dynamical Systems and Variational Inequalities with Applications,** Kluwer Academic Publishers, Boston, Massachusetts (1996).

Kudos and Congratulations

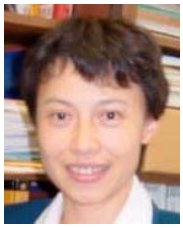
Jose M. Cruz received his PhD on May 22, 2004 from UMASS, Amherst. His dissertation title: **International Financial Networks and Global Supply Chains: A Unified Framework for Decision-Making, Optimization, and Risk Management**. Professor Anna Nagurney was his dissertation chair. Dr. Cruz will be joining the School of Business at the University of Connecticut as an Assistant Professor.

Jose Cruz and Professor Nagurney

Stephen Davis was one of 16 UMass Leaders of the 21st Century, recognized by Chancellor John Lombardi on May 23, 2004 at the undergraduate commencement ceremonies. Steve graduated with a degree in Operations Management and has accepted a position with Cintas Corporation in Pittsfield, MA. Congratulations to the Class of '04 Center Associates and many thanks for their outstanding contributions!

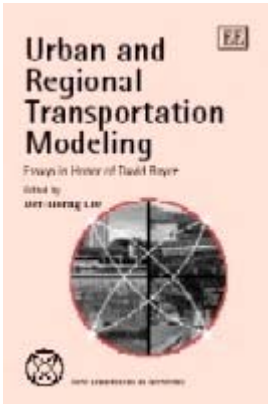
Stephen Davis

Professor June Dong



Center Associate, Dr. June Dong, was awarded a CES-Chow Teaching Fellowship to teach in China at the School of Management at Shanghai Normal University. This fellowship is sponsored, in part, by the Gregory and Paula Chow Foundation. Dr. Gregory Chow is a Professor of Economics at Princeton University.

New Book Published



The book ***Urban and Regional Transportation Modeling: Essays in Honor of David E. Boyce***, edited by Der-Horng Lee, published by Edward Elgar Publishing is available;
http://e-elgar.com
For additional information on this book and other books in the *New Dimensions in Networks* series see:
http://supernet.som.umass.edu

Center Associate News

This was a very busy term for the center associates! Jose Cruz, Dmytro Matsypura, and Fuminori Toyasaki team-taught an advanced undergraduate class in Management Science, FOMGT 456, and as part of that course, they and their students were asked by the UMASS Police Chief, Barbara O'Connor, to conduct a traffic management study for traffic flow at UMASS during graduation weekend. A student class project, co-authored by Stephen Davis, and other students can be found on the supernetworks site under "Student Projects." Their suggestions were implemented as part of the Commencement 2004 traffic plan.

Professor Nagurney gave invited talks at the University of Wisconsin, Madison, Virginia Tech, and at UMass this past term. She was also an invited participant in the 3rd NSF-ENG Cyberinfrastructure Workshop – Research Opportunities in Cyberengineering and Cyberinfrastructure, April 22-23, 2004, at Drexel University, Philadelphia, PA.

Professors June Dong and Ding Zhang traveled to Cancun, Mexico this past spring and presented the following papers (co-authored with Anna Nagurney) at the 2nd World Conference on POM: "Supply Chain Supernetworks with Random Demands," and "A

Supply Chain Network Economy: Cooperation vs. Competition." The conference took place April 30-May 3, 2004.

Professor Nagurney presented the paper, "A Supply Chain Network Perspective for Electric Power generation, Supply, Transmission, and Consumption," joint with Dmytro Matsypura at the CORS/INFORMS Conference in Alberta, Canada, May 16-19, 2004. This paper will also be presented at the International Conference in Computing, Communication and Control Technologies, in Austin, Texas, August 14-17, 2004. In addition, she presented the paper, "Statics and Dynamics of Global Supply Chain Networks with Environmental Decision-Making," joint with Jose Cruz and Fuminori Toyasaki. This paper is also being presented at the 9th Workshop on Economics and Heterogeneous Interacting Agents, at Kyoto University, Japan, May 27-29, 2004 by Fuminori Toyasaki.

Banff, Alberta, CORS/INFORMS Site

In addition, the paper, "Projected Dynamical Systems and Evolutionary (Time-Dependent) Variational Inequalities via Hilbert Spaces with Applications," by Monica Cojocaru, Patrizia Daniele, and Anna Nagurney will be presented at the High Performance Software for Nonlinear Optimization: Status and Perspectives, in Ischia, Italy, June 18-20, 2004. This conference was organized to honor Professor Panos Pardalos of the University of Florida on the occasion of his 50th birthday!

The Center Director notes that the 2004 Computing in Economics and Finance Conference will be held in Amsterdam, The Netherlands, July 9-10, 2004.

Tina Wakolbinger and Anna Nagurney will be giving a workshop entitled, "Supernetworks for the Management of Knowledge Intensive Dynamic Systems," at the Fourth International Conference on Knowledge, Culture, and Organisations at the University of Greenwich, London, England, August 2-6, 2004.

Professor Nagurney will also be busy serving on NSF panels this summer and participating in a variety of collaborative research projects and initiatives.

Additional conference and workshop information can be found at: http://supernet.som.umass.edu

Where are They Now?

Since many have asked us what are former undergraduate center associates doing, we provide below some updated information.

Christopher Bardi '03 is in the IT Leadership Program at United Technologies in Connecticut and is working as an ebusiness analyst. He is enrolled in the M. S. program at RPI in Hartford in Management Information Systems.

Christina Calvaneso '03 is now in Mexico, having been promoted by GE and is based in San Luis Potosi working in Finance at GE Rail, Mexico. Christina writes that she is enjoying working and living in Mexico tremendously.

David Soffer '03 returned from teaching ESL in Taiwan last Fall and is a production planner with Radio Waves, Inc. in North Billerica, MA.

Center Publications

Copies of these (and other) center articles may be found at:
http://supernet.som.umass.edu/dart.html

Supply Chain Supernetworks with Random Demand, June Dong, Ding Zhang, and Anna Nagurney, in ***Urban and Regional Transportation Modeling: Essays in Honor of David Boyce***, Der-Horng Lee, editor, Edward Elgar Publishing, Cheltenham, England (2004), pp. 289-313.

A Retrospective on Beckmann, McGuire, and Winsten's *Studies in the Economics of Transportation*, David E. Boyce, Hani S. Mahmassani, and Anna Nagurney (2004), revised and resubmitted to *Papers in Regional Science.*

Financial Networks with Intermediation: Risk Management with Variable Weights, Anna Nagurney and Ke Ke (2004).

Evolution Variational Inequalities and Projected Dynamical Systems with Applications to Human Migration, Anna Nagurney and Jie Pan (2004).

Projected Dynamical Systems and Evolutionary (Time-Dependent) Variational Inequalities via Hilbert Spaces with Applications, Monica Cojocaru, Patrizia Daniele, and Anna Nagurney (2004).

A Supply Chain Network Perspective for Electric Power Generation, Supply, Transmission, and Consumption, Anna Nagurney and Dmytro Matsypura (2004).

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Dr. Jose Cruz with Friends

Thank you for your support!