
The Supernetwork Sentinel

The Newsletter of the Virtual Center for Supernetworks

Summer 2009



Welcome to the Summer 2009 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, the Center Associates, and the Supernetworks Laboratory for Computation and Visualization. In this newsletter, we include an essay on highlights of recent presentations from Vienna to Rome by the Director. We also give information on a new book, update you on the World Science Festival in NYC, and mark notable distinctions and awards received by Center Associates. In addition, we share news about exciting upcoming events. As always, we include a list of our recent publications.

We wish everyone a wonderful summer!

Anna Nagurney
John F. Smith Memorial Professor
Director – Virtual Center for Supernetworks
<http://supernet.som.umass.edu>



Professor Anna Nagurney with some of the Participants in the NET2009 Conference in Rome, Italy

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World Science Festival Traffic Panel – June 12, 2009 (l-r) Robert Krulwich (ABC and NPR), Professor Iain Couzin (Princeton), Professor Anna Nagurney, and Professor Mitchell Joachim (Columbia)

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Highlights of Recent Presentations from Vienna to Rome

Anna Nagurney

My 2009 Speaking Engagements Calendar began with an invited talk on February 12th in the Dallas/Fort Worth Chapter Series of INFORMS (The Institute for Operations Research and the Management Sciences). I was hosted by Dr. Patricia Neri, who is the Vice President of this chapter. My travel experiences there seemed out of the *Planes, Trains, and Automobiles* movie with Steve Martin. I made it to the meeting venue at Southern Methodist University, after 11 hours of travel, with only 10 minutes to spare! My talk title was, **Synergies and Vulnerabilities of Supply Chain Networks in a Global Economy**. The audience was terrific and included faculty and students from universities in that area plus professionals from the airline industry, financial services, and others. Among them was Professor Eli Olinick, who like I, received his undergraduate degree from Brown University. We shared memories of several professors that we both had had as instructors!

On March 10, 2009, I had the enormous pleasure of delivering my lecture on supply chains at the Vienna University of Business and Economics in Austria. I was regally hosted by my esteemed colleague in regional science, Professor Manfred Fischer. This experience and the entire trip to Austria were simply magical. Having been a [Fulbrighter in Innsbruck, Austria, in 2002](#), my family first flew in for a few days to Innsbruck. There, I visited SOWI (the former name of the Business School at the University of Innsbruck), and saw my colleague, Dr. Richard Hule, whom we surprised. Although he was unaware of our visit, he was wearing an Isenberg School of Management t-shirt that I had given him 7 years ago! We also saw our former neighbors and visited our favorite restaurants. I guess that we had left an impression on Innsbruck, since one of the waiters in the Greek restaurant even remembered our usual order -- we always asked for the yogurt ambrosia as an appetizer! The train journey from Innsbruck to Vienna through Linz and Salzburg was like in a fairy-tale. Speaking at the Vienna University of Business and Economics in a forum filled with Full Professors (seated in the front row in assigned seats), students, and researchers, was a tremendous experience for me. I especially enjoyed the close interactions between academia and industry in Austria and the resulting excellence of both research and practice.

Juggling travel and speaking engagements, while continuing to teach and to be present when speakers that we host as part of the [UMass Amherst INFORMS Speaker Series](#) are in town, is quite the logistical challenge. However, meeting people and speaking face-to-face reinforces the information transferred and gathered and provide for deeper education for all those present as well as vivid memories. One can learn so much from questions from the audience and even identify new research directions.

On April 1, 2009, I had the great honor of speaking at Cornell University in Ithaca, New York, upon the invitation of Professor Kieran Donaghy, another dear colleague in regional science, who is Chair of the Department of City and Regional Planning. This experience filled me with nostalgia and respect for the truly great researchers in whose footsteps we hope to follow. The audience included: Professor Walter Isard, the founder of the field of regional science, who is 90 years old, Professor Sid Saltzman, who is the father of Professor Matt Saltzman of Clemson (well-known in computing and operations research), and Dr. Marc Eisner, who had worked with my thesis advisor, Dr. Stella Dafermos, when she was at Cornell after getting her PhD at Johns Hopkins. Plus, Professor June Dong of SUNY Oswego, who had just spoken in our speaker series at UMass Amherst, and who is on sabbatical this term, traveled to join us. At dinner, I had the thrill of also speaking to Professor Mark Turnquist of Cornell. As for the flight back, I encountered delays out of Ithaca airport but I got a chance to chat with Professor Linda Nozick and we shared front row

seats on USAir to Philadelphia. She was off to present in DC and I was heading back to Amherst through Bradley airport.

On April 16, 2009, I had the distinct honor of delivering the Kleber-Gery lecture at St. Olaf College in Northfield, Minnesota. I was hosted by my *academic brother*, Professor Steve McKelvey, whose doctoral dissertation chair at Brown University was also Professor Stella Dafermos. This endowed lecture was established to honor two faculty and the lecture should be of interest to both the Departments of Mathematics and Economics. My lecture was, **Synergies and Vulnerabilities of Supply Chain Networks in a Global Economy: What We Can Learn from Half a Century of Advances in Transportation**. It was such a delight to visit this idyllic campus and to meet Professor McKelvey's wonderful colleagues and the bright students at St. Olaf. I even got to stay at a hotel that was a former stagecoach inn.

On May 1, 2009 I was to be speaking at the Institute of Transportation Studies at the University of California Davis and my hosts were: Professor Patricia L. Mokhtarian (with whom, along with Professor June Dong, I had had a multi-year National Science Foundation grant) and Professor Yueyue Fan. I was very excited to have the opportunity to see the UC Davis campus and to interact with the very distinguished group in transportation there. However, the Director of WHO declared that the swine flu had reached a pandemic level and I was advised not to travel that week because of all the uncertainty. Nevertheless, "the talk had to go on," so with the wonderful assistance of our information technology staffs at the Isenberg School and at UC Davis, we video-streamed my lecture live ([and it is now available on the Internet](#)). I got to see the UC Davis audience in "real-time" on a video screen at the Isenberg School and to interact with a slight delay. This was definitely a unique experience and rewarding in its own way plus we experimented with a relatively new medium and technology for us. My doctoral students graciously provided me with a face-to-face audience that late Friday afternoon.

After the UMass Amherst graduations, May 22-23, 2009, I was off to give a plenary talk, **To Merge or Not to Merge: Multimarket Supply Chain Network Oligopolies, Coalitions, and the Merger Paradox**, at the NET2009 Conference in Rome, Italy. My gracious host was Professor Giulia Rotundo. This conference brought together researchers on networks from different fields to La Sapienza University. The talks were interdisciplinary and the audience included physicists, applied mathematicians, economists, operations researchers, and engineers. Speakers hailed from five continents and the talks and discussions were fascinating and very stimulating. Rome, during that period, was the site for the European soccer championship, so it was more lively than usual. My accommodations were at the "House for Aviators," so I was surrounded by men in uniform. The food in Rome was simply exquisite!

As for June activities, please see the writeup on the experiences at the World Science Festival in New York City that follows. Many of the above-noted presentations can be found [here](#).

New Book – *Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World*

We are delighted to announce that *Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World*, co-authored by Professor Anna Nagurney and Dr. Qiang "Patrick" Qiang, has been published by John Wiley & Sons! The book is the culmination of several years of research by the co-authors and provides a unified treatment of the vulnerabilities that exist in real-world network systems, along with tools to identify synergies for mergers and acquisitions. The book consists of three parts: Part I focuses on the network fundamentals, efficiency measurement, and vulnerability analysis. Part II discusses applications ranging from transportation networks and supply chains to electric power generation and distribution networks, the Internet, and financial networks. It also examines the efficiency changes and the

associated cost increments after network components are eliminated or partially damaged. Part III provides models and analyses for assessing mergers and acquisitions, network integration, and associated synergies.



The authors with *Fragile Networks*

According to the publisher, *Fragile Networks*, with its numerous network examples and real-

world applications, is an excellent book for courses in network science, transportation science, operations management, and financial networks. It is also a valuable reference for researchers and practitioners in the areas of applied mathematics, computer science, operations research, management science, finance and economics, as well as industrial, systems, and civil engineering. Additional information about the book can be found at: <http://supernet.som.umass.edu/bookser/fnetbook.html>

The World Science Festival in NYC

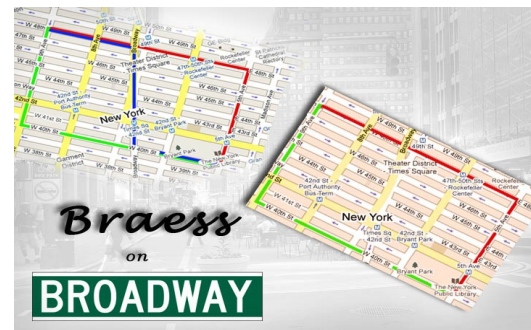
On Friday, June 12, 2009, Professor Anna Nagurney took part with Drs. Iain Couzin of Princeton University and Mitchell Joachim of Columbia University in the **Traffic: From Insects to Interstates** panel, as part of the [World Science Festival](http://worldsciencefestival.com/2009/traffic) in New York City. The panel moderator was Robert Krulwich of ABC and NPR, who has been called "the most inventive journalist." The **Traffic** event; see: <http://worldsciencefestival.com/2009/traffic> took place from 7:00-8:30PM at the Kimmel Center at New York University. Dr. Couzin is a biologist who studies animal behavior, including swarming, whereas Dr. Joachim is an architect who also designs collapsible cars. The audience for the event ranged from high school and college students to transportation professionals to journalists to academics and those who are simply fascinated by traffic. The event was also covered by bloggers from *Discover* magazine and *Nature*. Professor Lan Zhao of SUNY Old Westbury, a collaborator of Professor Anna Nagurney's and an academic sister of hers, came to the event and brought her son and several friends. She was joined in the audience by several members of Professor Nagurney's family.

Professor Anna Nagurney had a wonderful time being part of the panel and the World Science Festival, in general. This is the second year of this festival, which was founded by Professor Brian Greene of Columbia University and his journalist wife, Tracy Day. This year's festival began with a gala at Alice Tully Hall in Lincoln Center, complete with a performance by Yo-Yo Ma. It also served as the venue in which to celebrate the 80th birthday of Professor E. O. Wilson, the renowned Harvard University biologist. This year's program included interviews of the Nobel Prize winner, Dr. Harold Varmus, by high school students, along with a concluding science street fair on Sunday, June 14. New York City was transformed into a mecca celebrating a plethora of scientific discoveries and explorations.

There was particular interest in the **Traffic** panel because of the recent initiative of Mayor Bloomberg to close Broadway from 42nd to 47th Street. Professor Anna Nagurney discussed this initiative as a realization of an inverse of the [Braess paradox](#).

Media coverage of the **Traffic** panel as well as the radio interview of Drs. Iain Couzin and Anna Nagurney on The Brian Lehrer Show, June 11, 2009, in NYC, can be found at: <http://supernet.som.umass.edu/media/media.htm>

Both Brian Lehrer and Robert Krulwich were outstanding as interviewers and moderators!



Graphic from Nagurney's **Traffic** panel segment

Reflections on the Spring 2009 UMass Amherst INFORMS Speaker Series

The [Spring 2009 UMass Amherst INFORMS Speaker Series](#) was a big success. This Speaker Series is organized by the UMass Amherst Student Chapter of INFORMS (The Institute for Operations Research and the Management Sciences). Professor Anna Nagurney serves as the Faculty Advisor to the chapter and its Speaker Series. Funding is provided by the John F. Smith Memorial Fund, with additional support from the Isenberg School of Management and its Department of Finance and Operations Management plus INFORMS. This past spring was the tenth semester of the continuous operation of this series. To-date, approximately 70 speakers have been hosted through this speaker series.

Professor Ellis Johnson of Georgia Tech, a member of the National Academy of Engineering, spoke on **Major Airline Challenges and OR (Operations Research)** on February 20, 2009. His visit was especially timely, since he was the doctoral dissertation advisor of Dr. Senay Solak at the Georgia

Institute of Technology, who joined the faculty of the Isenberg School last Fall.



Professor Ellis Johnson with faculty and students

Professor Hari Balasubramanian regaled the audience on March 6, 2009, when he spoke on **Healthcare Operations Research Examples from the Mayo Clinic**. Dr. Balasubramanian joined the faculty of the Department of Mechanical and Industrial Engineering at UMass Amherst in the Fall of 2009. He held a post-doc at the Mayo Clinic in Rochester, Minnesota after receiving his doctorate from Arizona State University.

Center Associate Professor June Dong of the School of Business at SUNY Oswego, who is completing her sabbatical, visited UMass Amherst in March 2009. She delivered a talk, **Supply Chain Disruptions**, in the UMass Amherst INFORMS Speaker Series in Operations Research / Management Science. She discussed recent real-world disruptions in supply chains ranging from the contamination of infant formula to the impact of the economic crisis on automobile manufacturing and how that is affecting pharmaceutical supply chains. During her visit to UMass Amherst Professor Dong also took part in Patrick Qiang's doctoral dissertation defense.

Professor Alex "Sandy" Pentland of Media Lab at MIT, whose research on networks, sensing, and signal processing has attracted vast media attention, including multiple coverage in the *New York Times*, spoke on April 3, 2009. His talk, **Honest Signals and Reality Mining**, generated lots of discussion and comments. His book, **Honest Signals**, MIT Press, was made available for purchase and signing during his visit. After reading the book, one gets deep insights into human interactions.

Professor Hillel Bar-Gera of Ben-Gurion University spoke on April 24, 2009. The title of his presentation was, **Traffic Assignment by Paired Alternative Segments (TAPAS)**. Professor Bar-Gera is an expert on large-scale transportation network modeling and algorithms for traffic prediction. This year he has been visiting the University of Arizona and Purdue University.



Lunch at the University Club with Professor Pollin

Professor Robert Pollin of the Department of Economics and the Political Economy Research Institute at UMass Amherst spoke on **How Green Growth Can Revive the Economy** on May 8, 2009. His research has attracted volumes of positive press, including recognition from President Obama and his administration.

The Center Director, Professor Anna Nagurney, thanks all of the above speakers for their outstanding presentations that added so much to the intellectual life of UMass Amherst this past semester. Your talks and visits provided enrichment to both research and education and we were greatly honored to be able to host you.

This past year, Center Associates Amir Masoumi and Min Yu served, respectively, as President and Vice-President, of the award-winning [UMass Amherst INFORMS Student Chapter](http://supernet.som.umass.edu/visuals.htm). We thank them and the other Chapter Officers for their outstanding leadership and contributions!



UMass Amherst INFORMS Student Chapter Officers recognized with Award Certificates at the End of the Semester Party

Many of the above presentations are available at: <http://supernet.som.umass.edu/visuals.htm>

Kudos and News

Welcome to our newest Center Associate, Dr. Lan Zhao of the Department of Mathematics and Computer Science at the State University of New York at Old Westbury. Dr. Zhao is a Full

Professor and received her PhD in Applied Mathematics from Brown University. She has published on a range of network equilibrium problems in transportation, economics, and marketing (including on Internet advertising) in such top journals as: *Transportation Science*, *Operations Research Letters*, *Networks*, and the *European Journal of Operational Research*. She is a sought after quantitative consultant and has worked on projects for 1800Flowers.com, among other clients. Welcome to Center Associate Professor Lan Zhao!

Congratulations to Center Associate Professor Ding Zhang, who is the MBA Director at the School of Business at SUNY Oswego! Professor Zhang is the recipient of the **2009 SUNY (State University of New York) Chancellor's Award for Excellence in Scholarship and Creative Activities**. This announcement was made in April 2009 and Professor Zhang will receive the award in the commencement ceremonies next December. SUNY Oswego President Deborah F. Stanley stated that Zhang "has a reputation as a world-class scholar and is an expert in transportation science and supply chain management." In addition, she said, "He inspires students by serving as a role model for high achievement through persistence and hard work." Previously, Professor Zhang was recognized both with the SUNY Oswego President's and Provost's Award for Scholarly and Creative Activity. Besides his outstanding publication record, he also has received major grants from the National Science Foundation in China and is spending part of this summer on research activities in China.

Center Associate Qiang "Patrick" Qiang received his PhD in ceremonies at UMass Amherst on May 22, 2009. His dissertation title was, **Network Efficiency/Performance Measurement with Vulnerability and Robustness Analysis with Application to Critical Infrastructure**. Dr. Qiang was supported by a Graduate Fellowship this past year from the University of Massachusetts Amherst. Dr. Qiang will be joining the faculty at the Pennsylvania State University Great Valley School of Graduate Professional Studies later this summer. This Penn State campus is located in the Philadelphia region. Dr. Qiang will be continuing his research on vulnerability analysis of complex networks, supply chain disruptions, and applications. Dr. Qiang will be instructing MBA courses. We congratulate him and wish him well in his new position as an Assistant Professor of Operations Management!

Center Associate Dr. Stavros Siokos, who is Head of Deposits & Investment Management for the Piraeus Bank in Athens, Greece, delivered a talk, **The Latest Dynamics in the Private Equity Fund & Venture Capital Industry**, in the Asset Management Forum on May 20, 2009 at The American School of Classical Studies in

Athens, Greece. Dr. Siokos is a widely sought after expert and speaker on international finance and investments.



Dissertation defense of Patrick Qiang

Center Associate Professor Patrizia Daniele of the Department of Mathematics and Computer Science at the University of Catania, Italy, was a member of the Organizing Committee of the International School of Mathematics "G. Stampacchia" for the 51stst Workshop on "Variational Analysis and Applications," in Erice, Italy, which took place May 9-17, 2009. She delivered the lecture, **Evolutionary Variational Inequalities and Applications to Complex Dynamic Multi-level Models**. Erice is located on the island of Sicily and is a magnificent, historical venue for scientific exchanges.



Professor Patrizia Daniele with her son

Center Associate Professor Tina Wakolbinger of the Fogelman College of Business and Economics at the University of Memphis was recognized this past semester by Dean Rajiv Grover of the Fogelman College for her outstanding service regarding the organization of the Dean's 2008 Speaker Series, which brought speakers to the University of Memphis for both academic and business audiences. Congratulations to Dr. Wakolbinger for her receipt of the 2008-2009 Dean's Service Award!

Professor Wakolbinger continues to serve as Junior Vice President of Communications of WOMS (Women in Operations Research and the Management Sciences) of INFORMS; <http://worms.forum.informs.org/>



Professor Tina Wakolbinger receiving the Dean's Service Award at the University of Memphis

Center Associate Professor Ladimer S. Nagurney is spending the 2008-2009 year on sabbatical at the NSF Engineering Research Center for the Collaborative Adaptive Sensing of the Atmosphere, CASA, whose lead institution is UMass Amherst. The primary goal of CASA is to develop a network of small weather radars that may be located on cell towers to monitor local weather while feeding the data into a larger grid for severe weather prediction. While at CASA he is collaborating with Professors Steve Frasier and Dave McLaughlin on using Software Defined Radio techniques for pulse generation in a solid state X-band weather radar. By implementing an SDR transmitter in the radar, it will be easy to remotely update the transmitted pulse shape, length, and repetition rate, a key feature for remotely mounted radars. The network of experimental CASA radars was part of the VORTEX2 project that studied the formation and lifecycle of tornados this Spring. VORTEX2 has had widespread coverage in the media, including coverage on the Weather Channel.

Professor Ladimer Nagurney also participated in the Brown University Physics Department Degree Day program on April 4, 2009. The program brought 38 graduate alumni back to the Brown campus to discuss career options and paths with current Brown doctoral students. Dr. Ruth Simmons, the President of Brown University, welcomed the alumni and students.



Professor Ladimer Nagurney (center) with fellow physics alums Dr. Martin Heller and Dr. Thomas N. Theis

We congratulate Center Associate Professor Zugang "Leo" Liu of Pennsylvania State University Hazleton for the acceptance of his paper, **An Integrated Electric Power Supply Chain and Fuel Market Network Framework: Theoretical Modeling with Empirical Analysis for New England**, in the journal *Naval Research Logistics*. The paper is co-authored with Professor Anna Nagurney and is the first to provide both theoretical and empirical frameworks for large-scale electric power supply chains. The computer-based models can serve as test-beds for, among others, the smart grid as well as for the evaluation of emissions generated and vulnerability and robustness analyses.

Also, we congratulate Professor Liu for the acceptance of his paper, **Stock Market Crashes, Firm Characteristics, and Stock Returns**, co-authored with Professors Jia Wang, G. Meric, and I. Meric, which is forthcoming in the *Journal of Banking and Finance*.

Center Associates have been engaged in not only vulnerability analysis of complex network systems but, also, in identifying possible synergies through network integration using multidimensional methods. We congratulate Center Associate Trisha Woolley for the acceptance of two of her papers. The paper, **Multiproduct Supply Chain Horizontal Network Integration: Models, Theory, and Computational Results**, co-authored with Drs. Anna Nagurney and Qiang, is in press in the journal, *International Transactions in Operational Research* (2009). The paper, **Environmental and Cost Synergy in Supply Chain Network Integration in Mergers and Acquisitions**, co-authored with Anna Nagurney, is in press in: *Sustainable Energy and Transportation Systems, Proceedings of the 19th International Conference on Multiple Criteria Decision Making, Lecture Notes in Economics and Mathematical Systems* (2009), M. Ehrgott, B. Naujoks, T. Stewart, and J. Wallenius, Editors, Springer, Berlin, Germany. These proceedings are based on a conference that took place in January 2008 in Auckland, New Zealand, at which Professor Anna Nagurney was a plenary speaker.

Center Associate Professor Jose M. Cruz of the School of Business at the University of Connecticut Storrs is the track chair for Supply Chain Management for the Eastern Academy of Management Conference in Rio de Janeiro, Brazil, June 21-25, 2009. The theme of the conference is: Managing in a Global Economy.

Center Associate Dr. Ke "Grace" Ke completed her first year as an Assistant Professor in the Department of Finance and Operations and Supply Chain Management at the School of

Business at Central Washington University. She has been teaching a wide variety of supply chain management courses and is based in the Seattle area.

Center Associates will be taking part in the 20th International Symposium on Mathematical Programming to be held in Chicago, Illinois, August 23-28, 2009. In particular, Anna Nagurney has organized a session: **Game Theory and Variational Inequalities**, in which Center Associates Professors Daniele, Liu, and Qiang are invited speakers. This promises to be a terrific scientific conference; see: <http://ismp2009.eecs.northwestern.edu/>

For more information on the talks, conferences, and upcoming events, see: <http://supernet.som.umass.edu/conferences.html>

In concluding this Kudos and News section, we would like to welcome the new Dean of the Isenberg School of Management, Dr. Mark A. Fuller, who will be assuming this position this summer on August 1, 2009. Dr. Fuller will also be holding the Thomas O'Brien Endowed Chair, named in honor of the former Dean of the Isenberg School. Dr. O'Brien, who served as dean for 19 years! A press release on the appointment of Dr. Fuller, who comes to us from Washington State University, where he chaired the department of Information Systems and held an endowed chair, can be found [here](#). We would also like to take this opportunity to thank Dr. Tony Butterfield for serving as the interim dean of the Isenberg School for the past two years. His outstanding service is truly appreciated by all.

We would also like to thank the UMass Amherst Chancellor, Dr. Robert C. Holub, for filling the Isenberg School of Management Dean's position.

Recent Center Publications

Copies of these (and other) center articles are at: <http://supernet.som.umass.edu/dart.html>

A Relative Total Cost Index for the Evaluation of Transportation Network Robustness in the Presence of Degradable Links and Alternative Travel Behavior, A. Nagurney and Q. Qiang, *International Transactions of Operational Research* (2009), **16**, pp. 49-67.

A System-Optimization Perspective for Supply Chain Network Integration: The Horizontal Merger Case, A. Nagurney, *Transportation Research E* (2009), **45**, pp. 1-15.

Spatially Differentiated Trade of Permits for Multipollutant Electric Power Supply Chains, T. Woolley, A. Nagurney, and J. K. Stranlund, in *Optimization in the Energy Industry* (2009), J. Kallrath, P. Pardalos, S. Rebennack, and M. Schei, Editors, Springer, Berlin, Germany (2009), pp. 277-296.

Network Economics, A. Nagurney, in *Handbook of Computational Econometrics* (2009), D. Belsley and E. Kontoghiorghes, Editors, John Wiley & Sons (2009), pp. 429-486.

An Integrated Electric Power Supply Chain and Fuel Market Network Framework: Theoretical Modeling with Empirical Analysis for New England, Z. Liu and A. Nagurney (2008), to appear in *Naval Research Logistics*.

Environmental Impact Assessment of Transportation Networks with Degradable Links in an Era of Climate Change, A. Nagurney, Q. Qiang, and L. S. Nagurney, *International Journal of Sustainable Transportation* (2009), in press.

Formulation and Analysis of Horizontal Mergers Among Oligopolistic Firms with Insights into the Merger Paradox: A Supply Chain Network Perspective, A. Nagurney, *Computational Management Science* (2009), in press.

Multiproduct Supply Chain Horizontal Network Integration: Models, Theory, and Computational Results, A. Nagurney, T. Woolley, and Q. Qiang, *International Transactions in Operational Research* (2009), in press.

Modeling of Supply Chain Risk Under Disruptions with Performance Measurement and Robustness Analysis, Q. Qiang, A. Nagurney, and J. Dong, *Managing Supply Chain Risk and Vulnerability: Tools and Methods for Supply Chain Decision Makers* (2009), T. Wu and J. Blackhurst, Editors, Springer, in press.

Environmental and Cost Synergy in Supply Chain Network Integration in Mergers and Acquisitions, A. Nagurney and T. Woolley, to appear in *Sustainable Energy and Transportation Systems, Proceedings of the 19th International Conference on Multiple Criteria Decision Making, Lecture Notes in Economics and Mathematical Systems* (2009), M. Ehrgott, B., Naujoks, T. Stewart, and J. Wallenius, Editors, Springer, Berlin, Germany.

Identification of Critical Nodes and Links in Financial Networks with Intermediation and Electronic Transactions, A. Nagurney and

Q. Qiang, in *Computational Methods in Financial Engineering*, E. J. Kontoghiorghe, B. Rustem, and P. Winker, Editors, Springer, Berlin, Germany (2008), pp. 273-297.

A Unified Network Performance Measure with Importance Identification and the Ranking of Network Components, Q. Qiang and A. Nagurney, *Optimization Letters* (2008), **2**, pp. 127-142.

An Efficiency Measure for Dynamic Networks with Application to the Internet and Vulnerability Analysis, A. Nagurney and Q. Qiang, *Netnomics* (2008), **9**, 1-20.

An Integrated Framework for the Design of Optimal Web Banners, L. Hai, L. Zhao, and A. Nagurney (2008), submitted.



Dr. Qiang "Patrick" Qiang with Professor Nagurney following UMass Amherst Graduate Ceremonies

The Center Director, Professor Anna Nagurney, and the Center Associates thank you for your support!

**Virtual Center for Supernetworks
Eugene M. Isenberg School of Management
University of Massachusetts at Amherst**

Center Director

Dr. Anna Nagurney
John F. Smith Memorial Professor

Center Associates

Dr. Jose M. Cruz
Dr. Patrizia Daniele
Dr. June Dong
Dr. Ke "Grace" Ke
Dr. Zengang "Leo" Liu
Dr. Ladimer Nagurney
Dr. Qiang "Patrick" Qiang
Dr. Padma Ramanujam
Dr. Stavros Siokos
Dr. Tina Wakolbinger
Dr. Ding Zhang
Dr. Lan Zhao

Doctoral Students

Amir Masoumi
Trisha Woolley
Min Yu

Center Website:

<http://supernet.som.umass.edu>

If you would like to be put on our email list,
contact supernet@som.umass.edu

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