The Supernetwork Sentinel

The Newsletter of the Virtual Center for Supernetworks

Fall 2009

Welcome to the Fall 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 fragile networks and prioritizing investments. We highlight the Fall 2009 Speaker Series and the UMass Amherst INFORMS Student Chapter and note recent 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.

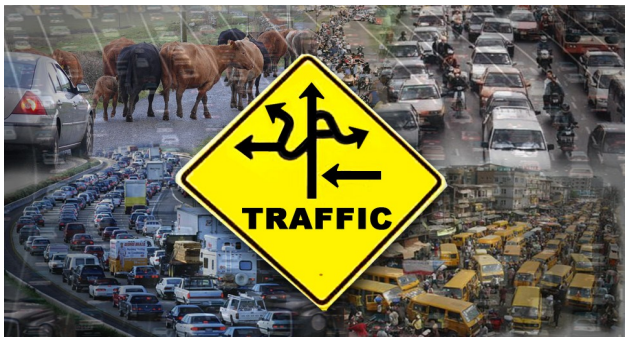
We wish everyone a terrific new academic year!

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

Professor Anna Nagurney with some of the UMass Amherst INFORMS Student Chapter Officers and Members

Trisha Woolley at her Doctoral Dissertation Defense – September 11, 2009

Inside



Fragile Networks: Prioritizing Investments in the Ties that Bind and Really Matter

Anna Nagurney

During the next several years, towns, cities, states, the nation, and the private sector will be making decisions on potentially huge investments towards the repair, rebuilding, and renewal of our roads, bridges, electric power lines, and telecommunication networks. While the current federal stimulus package aspires to the immediate commencement of construction for job and short-term economic growth, it is clear that the identification of project priorities is also of paramount importance.

The highest priority projects must be those that stop a direct threat to public health and safety, such as the repair of a gaping hole in a bridge deck, the reinforcement of a weakened school roof, the replacement of a missing guardrail, the filling up of the pothole or sinkhole that swallows up vehicles, and the insulation of a bare wire that is electrifying a manhole cover. As planning proceeds, and it is imperative that planning take place, the rankings of the next set of projects may be harder to define. However, these projects are as important as the initial ones and it is essential to prioritize them in a transparent and consistent manner that is quantitatively valid and justifiable. For example, suppose that two bridges have suffered the same degree of deterioration and that funding is available for the repair of only one bridge. How does one identify which bridge is more important to fix?

Our roads and bridges, electric power and telecommunication networks, schools and hospitals, manufacturing plants, and even financial networks have suffered from years' of neglect. The exposure now to increased vulnerability due to this deterioration and lack of investment is providing us with new opportunities and possibilities for synergies. However, without well-thought out planning and methodological assessments we may end up with roads that increase travel time for all, environmental "fixes" that actually increase pollution, and new telecommunication networks that slow down the flow of information in the Internet.

Indeed, our critical networks are not isolated from use and if we fail to capture the impacts of users on our networks and their behavior, the so-called "improvements" may actually make the citizens worse-off! For example, given two bridges to repair, not only must the structural repair question be answered but also such questions as: How will the traffic flow be improved by the proposed repairs and what is the economic impact? How will the repairs impact the environment? How will the repairs impact the flow of goods from the manufacturers to the consumers? Similarly, as we begin to invest in improvements to the electric power grid, which investments will result in higher reliability, less environmental impact, lower prices, and more job creation?

As part of the research on the book, *Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World*, Dr. Patrick Qiang and I have developed quantitative measures that identify and rank which are the most important nodes (think manufacturing centers, power plants, news bureaus, transportation centers) and links (think bridges, roads, fiber optic cables, electric power lines, etc.) in a network. Such computer-based tools are useful not only from a national security standpoint since they identify which nodes and links should be most protected since their elimination would cause the greatest disruptions, but also from an investment standpoint. Indeed, given a budget, where would improvements result in the greatest return on investment?

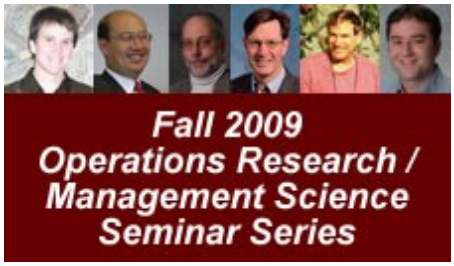
One can't just study the impacts of investments locally and selfishly but we must capture the potential

system-wide, societal interactions and benefits. As we know, the severance of a communication cable may disrupt Internet traffic globally; a lightning strike at a semiconductor manufacturing plant may result in millions in dollars in financial losses to a high-tech company thousands of miles away; a failure of a bank may propagate through the economy, and an electric power failure may impact numerous sectors, from airline travel to banking to healthcare. Furthermore, one must also be cognizant of counterintuitive phenomena that may prevail. For example, without capturing actual traveler's behavior on transportation networks the addition of a new road may result in increased travel time for all as in the case of the Braess paradox. We, as network scientists, were well aware that the closure of a road, hence, might actually improve travel time. With the closure of Broadway to traffic from 42nd to 47th Streets, New Yorkers are now experiencing this phenomenon.

Never has there been a time in our nation's history in which the partnering of educational institutions from research universities to community colleges with the public and private sectors has been more needed. Let's harness the brainpower, the best in mathematics, engineering, physics, environmental science, finance, and management to create the networks of tomorrow – more resilient and more robust than we have today!

Information on the *Fragile Networks* book published by John Wiley & Sons in 2009 is available at: http://supernet.som.umass.edu/bookser/fnetbook.html

The Fall 2009 UMass Amherst INFORMS Speaker Series



The Fall 2009 UMass Amherst INFORMS Speaker Series lineup is now available; please see: http://supernet.som.umass.edu/informs/speakernew.html. 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 semester marks the eleventh semester of the continuous operation of this series.

We are delighted to be hosting the following speakers this semester. Dr. Mary Helander of IBM, Yorktown Heights, will be speaking on September 18, 2009. Her talk is on food safety and global supply chains. Professor Andrew Lo of MIT will deliver his lecture on finance and the economic crisis on October 2, 2009. His seminar is co-hosted by the Finance Seminar Series. On October 23, we are delighted that Professor Jose Holquin-Veras, the Chairman of the Department of Civil and Environmental Engineering at RPI in Troy, NY, will be speaking on Hurricane Katrina and the lessons learned.

On November 6, 2009, Professor Palmer, the Chairman of the Civil and Environmental Engineering Department at UMass Amherst, will speak on his research in optimizing reservoir operations.

The next speaker in the Fall 2009 series will be Professor Sam Bowles, who is a Professor Emeritus of the Economics Department at UMass Amherst and is a Professor at the University of Siena in Italy and at the Santa Fe Institute in New Mexico. He will be talking on the nature of wealth and the dynamics of inequality.

The Fall 2009 Speaker Series will conclude on December 4, when we host Professor Brian Levine of the Computer Science Department at UMass. His talk will be on forensic investigation of the Internet and mobile systems. All talks take place on Fridays at 11AM until noon in the Isenberg School of Management. This series is open to the public.

The UMass Amherst INFORMS Student Chapter Garners National Award

The UMass Amherst INFORMS Student Chapter was (re)established in Fall 2004, after a period of dormancy, and is now celebrating its fifth anniversary. Its activities, from the Speaker Series that it organizes, to its social and professional activities, have been recognized nationally. In 2006, Dr. Tina Wakolbinger, the first President of the Chapter, received the Judith Liebman Award from INFORMS. In 2007, its Faculty Advisor, Professor Anna Nagurney, received the Moving Spirit Award. In the past two years, the chapter has received the Summa Cum Laude Award and the Magna Cum Laude Award from INFORMS, awarded at the annual meeting of INFORMS.

On October 13, 2009, the UMass Amherst INFORMS Student Chapter will be recognized with the Summa Cum Laude Award at the Annual INFORMS Meeting in San Diego, California. This is the highest award that a student chapter can receive and is based on the annual report that each chapter submits to INFORMS, which is the largest society of professionals in operations research and the management sciences, with over 10,000 members. This year, the chapter received the highest ranking by the committee of 32 chapters that submitted their annual reports. The award will be given at the breakfast for chapters and fora.

The President last year of the UMass Amherst INFORMS Student Chapter was Center Associate Amir Masoumi and the Vice President was Center Associate Min Yu. At the chapter meeting and election on September 9, 2009, which marked the chapters 5th anniversary, Min Yu was elected President and Amir Masoumi will continue as the Speaker Series Coordinator for 2009-2010.

We congratulate all the chapter officers for the truly great achievement and recognition of the Summa Cum Laude Award! Professor Anna Nagurney, along with several student chapter members, will be at the award ceremony in San Diego to receive the award plaque.

Professor Qiang Receives the Judith Liebman Award

Center Associate Professor Patrick Qiang was selected by the Subdivisions Council of INFORMS as the recipient of the 2009 Judith Liebman Award. The award will also be presented at the INFORMS Annual Meeting in San Diego on October 13, 2009 at the chapter/fora breakfast and award ceremonies. Dr. Qiang received his PhD from UMass Amherst on May 22, 2009. His concentration was Management Science. He is now an Assistant Professor at the Graduate School of Professional Stusdies at Pennsylvania State University in Malvern and is teaching MBA courses.

Dr. Qiang served as the President, Vice-President, and as the webmaster of the UMass Amherst INFORMS Student Chapter and was a role model member of the chapter for 5 years. He helped to host over 70 speakers in its speaker series and welcomed new members plus helped to organize educational and social activities for the chapter.

More information about INFORMS awards and Dr. Judith Liebman, after whom this INFORMS National Award has been named, is available at: http://www.informs.org/Prizes/whoisLiebman.html

Farewell luncheon for Dr. Qiang prior to his move to Pennsylvania State University

Professor Nagurney Lectures in Executive Education at Harvard

Professor Anna Nagurney was appointed an Instructor in Executive Education at Harvard University in 2009 and last July taught a course on Portfolio Optimization at the Graduate School of Design. The students in the course came from the North America, Europe, Asia, South America, Africa, and Australia.

The topics that Professor Nagurney addressed in the course, and accompanying handouts, included: foundations of modern portfolio theory, a historical perspective of financial economics, utility theory and risk, behavior of markets, international economics and finance, and new and novel approaches to enhance financial-decision-making, including network theory. She used material from the **Fragile Networks: Identifying Vulnerabilities and Synergies in an Uncertain World** book as well as from the **Financial Networks: Statics and Dynamics** book, which she co-authored, respectively, with Center Associates, Professor Patrick Qiang and Dr. Stavros Siokos. She also included discussions of recent articles in *Forbes* and *The Economist* to bring an immediacy to portfolio optimization and the financial crisis.

Professor Nagurney at Harvard's Graduate School of Design

Center Associates Excel in Activities in China

Professor Ding Zhang of the School of Business at SUNY Oswego, who is also the MBA Director, spent the summer in China. He gave numerous lectures on topics of supply chain coordination, supply chain disruptions, and competition, plus on transportation network management. The institutions that he visited while in China: Fudan University in Shanghai, Zhe Jiang Gongshang University in Hanzhou, Shanghai Normal University, Nanjing University of Technology, China University of Mining and Technology, Wuhan University of Technology, Harbin University of Science and Technology, the Chinese Academy of Sciences, and Henan University of Science and Technology in Luoyang.

Professor Zhang lecturing on supply chains in China

While at Fudan University, he participated in the defense of his project for which he was the Co-PI and Professor Daoli Zhu of Fudan was the PI. The multi-year project was funded by the National Science Foundation of China.

Dr. Zhang with students and colleagues in Hangzhou

In addition, Dr. Zhang led a group of students from SUNY Oswego to Hangzhou, China for the first Spoken English Promotion Project at Zhe Jiang Gongshang University. There he also delivered a course, "Topics in Chinese Culture and Business."

Professor June Dong, also of the School of Business at SUNY Oswego, spent the summer in China as well and was engaged in a variety of scholarly activities. She delivered a series of lectures on Supernetworks at a workshop at the Shanghai Science and Technology University. Also, she gave the presentation, *Supply Chain Disruptions*, at the Second Annual Conference of the Overseas Scholars Association in Management Science and Engineering, which took place July 6-8, 2009, in Shanghai.

Center Associate Professor Lan Zhao of the Department of Mathematics and Computer and Information Science at SUNY Old Westbury spent her sabbatical in China. She gave a course on Marketing Science in the MBA program at the Shandong Finance Institute and was granted a Visiting Professorship by the School of Business at Chongqing University.

In addition, Professor Zhao gave the following presentations, **A Network Equilibrium Framework for Internet Advertising: Models, Quantitative Analysis, and Algorithms,** in the Guang Hua Forum of the Southwestern University of Finance and Economics, and **Optimization of Internet Banner Advertising by Statistical Predictive Model and Mixed Mathematical Program**, at Chongqing University and at the Southwestern University of Transportation. The former presentation was based on the paper with the same title co-authored with Professor Anna Nagurney, and published in the *European Journal of Operational Research* in 2008.

Center Associates at the INFORMS San Diego Annual Meeting

Center Associates will be well-represented at the Annual INFORMS Meeting, which takes place in San Diego, October 11-14, 2009.

Professor Zugang Liu will present the paper, **Stochastic Transportation Networks with Routing Inertia and Scenario Preference: Theoretical Basis and Modeling Method**, which is joint work with Chi Xie at the University of Texas at Austin.

Professor Tina Wakolbinger will deliver the paper, **An Analysis of Fundraising Strategies for Disaster Relief Operations,** which is joint work with Professor Fuminori Toyasaki of York University.

Professor Jose M. Cruz will speak on **Corporate Social Responsibility and Globalization: A Supply Chain Network Framework** and on **Computational Grid Networks Market Design: QoS, Reliability, Efficiency and Risk Management.**

Professor Anna Nagurney will present the paper, **Formulation of Mergers Among Oligopolistic Firms with Insights into the Merger Paradox**.

Kudos and News

Congratulations to Center Associate Trisha Woolley, who successfully defended her doctoral dissertation: **Sustainable Supply Chains: Multicriteria Decision-Making and Policy Analysis for the Environment**, on September 11, 2009. Her concentration was Management Science. She has assumed a tenure-track Assistant Professorship in Management at the School of Business Administration at Texas Wesleyan University in Fort Worth.

Congratulations to Center Associate, Dr. Jose M. Cruz of the School of Business at the University of Connecticut in Storrs! Professor Cruz has recently received two grants: a CIBER Grant for International Business Research for the project, **Corporate Social Responsibility and Globalization**, and a Connecticut Information Technology Institute (CITI) Grant.

In addition, Professor Cruz's paper, **Corporate Social Responsibility in Supply Chain Management: Multicriteria Decision-Making Approach**, has been accepted for publication in the *Decision Support Systems Journal*.

Kudos also to Professor Tina Wakolbinger of the Fogelman College of Business and Economics at the University of Memphis. Her paper, joint with Professor Cruz, **Multiperiod Effects of Corporate Social Responsibility on Supply Chain Networks, Transaction Cost, Emissions, and Risk**, which appeared in the *International Journal of Production Economics* (2008), **116**, 61-74, has been recognized with the 2008 Best Paper Award of the Fogelman College in the conceptual/theoretical category. Congratulations to Center Associates Professors Wakolbinger and Cruz!

Dean Rajiv Grover of the Fogelman College of Business and Economics presents paper award to Professor Wakolbinger

Professor Anna Nagurney chaired the 2009 Women in Operations Research and the Management Sciences (WORMS) Award Committee. The award will be given at the INFORMS Annual Meeting in San Diego, California at the WORMS luncheon on October 13, 2009.

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

Center Associates Dr. Zugang Liu and Dr. Patrick Qiang took part in the 20th International Symposium on Mathematical Programming (ISMP) held in Chicago, Illinois, August 23-28, 2009. In particular, they spoke in the invited session that Anna Nagurney organized, entitled: **Game Theory and Variational Inequalities.** The session took place in the University of Chicago's Booth School of Business Gleacher Center. This was a terrific scientific conference; see: http://ismp2009.eecs.northwestern.edu/

Professors Qiang, Nagurney, and Liu at ISMP in Chicago

Dr. Qiang delivered the paper, **Modeling of Supply Chain Risk Under Disruptions with Performance Measurement and Robustness Analysis**, co-authored with Professors June Dong and Anna Nagurney. Dr. Liu presented the paper, **An Integrated Electric Power Supply Chain and Fuel Market Network Framework: Theoretical Modeling with Empirical Analysis for New England,** joint with Nagurney**.** Both of these papers are now in press. Nagurney spoke on **Evolutionary Variational Inequalities and the Internet,** which is joint work with Center Associate Patrizia Daniele of the University of Catania in Italy and Professor David Parkes of Harvard University.

Professor Patrizia Daniele presented a paper with Professor Antonino Maugeri at the 23rd EURO Conference on Operational Research in Bonn, Germany, which took place July 5-8, 2009. The title of the paper was: **Infinite Dimensional Duality and Applications to**

Complex Networks. While at the conference, she had an opportunity to see Professor Dmytro Matsypura of the University of Sydney.

Professor Daniele with Professor Scrimali and Matsypura with spouse in Bonn, Germany

We congratulate Professor Lan Zhao on the acceptance of her paper, **Optimization of Integrated Procedure of Internet Marketing**, which will appear in the E*ncyclopedia of E-Business Development and Management in the Digital Economy*, edited by In Lee. Also, her paper, **An Integrated Framework for the Design of Optimal Web Banners**, co-authored with Professors Lili Hai and Anna Nagurney, has been accepted for publication in *Netnomics*.

Center Associate Professor Ladimer S. Nagurney completed his sabbatical at the Center for the Collaborative Sensing of the Atmosphere, CASA, at the University of Massachusetts Amherst, and has returned to the University of Hartford. He will be presenting the paper, **Software Defined Radio in the Electrical and Computer Engineering Curriculum**, at FIE'09 in San Antonio, Texas, October 19-21, 2009.

We welcome the new Dean of the Isenberg School of Management, Dr. Mark A. Fuller, who assumed this deanship on August 1, 2009. Dr. Fuller is also the holder of 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 can be found here. We again thank Dr. Tony Butterfield for serving as the interim dean of the Isenberg School for the past two years. His outstanding service was very appreciated.

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.

Environmental and Cost Synergy in Supply Chain Network Integration in Mergers and Acquisitions, A. Nagurney and T. Woolley, 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, in press.

Modeling of Supply Chain Risk Under Disruptions with Performance Measurement and Robustness Analysis, Q. Qiang, A. Nagurney, J. Dong, in *Managing Supply Chain Risk and Vulnerability: Tools and Methods for Supply Chain Decision Makers*

(2009), T. Wu and J. Blackhurst, Editors, Springer, in press.

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* (2008), E. J. Kontoghiorghes, B. Rustem, and P. Winker, Editors, Springer, Berlin, Germany, 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), to appear in *Netnomics*.

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. Zugang "Leo" Liu
Dr. Ladimer Nagurney
Dr. Qiang "Patrick" Qiang
Dr. Padma Ramanujam
Dr. Stavros Siokos
Dr. Tina Wakolbinger
Dr. Trisha Woolley
Dr. Ding Zhang
Dr. Lan Zhao

Doctoral Students

Amir Masoumi
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