Overview of the Virtual Center for Supernetworks

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UMassAmherst

Isenberg School of Management

Outline

- Background and Motivation
- Research and Impact
- Outreach and Impact
- Accolades
- Going Forward

Background and Motivation

Background and Motivation

In 1998, I had the honor of being appointed the John F. Smith Memorial Professor and meeting the benefactor, Jack Smith Jr., Isenberg class of 1960, who endowed the professorship in honor of his father.

- Jack Smith Jr. was the chairman of the board of General Motors from 1996 to 2003 and the CEO from 1992 to 2000.
- He is the non-executive Chairman of the Board of Directors of Delta Air Lines and a member of Delta's Board of Directors since 2000.



Supernetworks

Supernetworks are networks of networks and their applications are vast and growing.



The Virtual Center for Supernetworks is an interdisciplinary center at Isenberg that advances knowledge on large-scale networks and integrates operations research and management science, engineering, and economics.

Mission

Mission:

The Virtual Center for Supernetworks fosters the study and application of supernetworks and serves as a resource on networks ranging from transportation and logistics, including supply chains, and the Internet, to a spectrum of economic networks.

Applications of Supernetworks Include:

decision-making, optimization, and game theory; supply chain management; critical infrastructure from transportation to electric power networks; financial networks; knowledge and social networks; energy, the environment, and sustainability; cybersecurity; Future Internet Architectures; risk management; network vulnerability, resiliency, and performance metrics; humanitarian logistics and healthcare.

The Website



We utilize modeling, optimization, network and game theory, and also dynamical systems, accompanied by algorithms and data, to gain insights as to the behavior of stakeholders and impacts.

Founding of the Center

The Virtual Center for Supernetworks was established in the Fall of 2001, after my receipt of 3 NSF grants in 2000 plus an AT&T Industrial Ecology Fellowship in 2001, which proposed the development of such a center.



Since November 2003, physical space has been provided at Isenberg, where the Supernetwork Laboratory for Computation and Visualization is also housed, now in Room G11.

Initial Funding

- Three-year, \$299,879 grant, "Decentralized Decision Making in Complex Network Systems," with June Dong of SUNY Oswego, and Patricia Mokhtarian at the UC Davis: examining how telecommuting and teleshopping affect both transportation and communications networks. Total from 2000-2007: \$711,125. Supplement received through the Management of Knowledge Intensive Dynamic Systems Program (MKIDS): Knowledge Supernetworks: Modeling and Management of Dynamics of Complex Business Processes Under Risk and Uncertainty.
- Three-year, \$28,515 grant, "U.S. Sweden Collaborative Research: Sustainable Transportation and Land Use in the Information Society," with researchers at the Royal Institute of Technology in Stockholm to develop a land use and transportation model based on data from Sweden with the goal of environmental sustainability.
- One-year, \$140,000 grant, "Enterprise-Wide Simulation and Modeling of Comprehensive Freight Movements," with Kathleen Hancock of UMass and Frank Southworth of the Oak Ridge National Laboratory. Project analyzes how freight costs influence the movement of goods in the US in the age of e-commerce.

Additional Funding



This support is gratefully acknowledged.

Inclusion of Undergraduates

- We leveraged the NSF grants to acquire funding for Research Experiences for Undergraduates (REUs) allowing for multiple undergraduates to take part in research at the Center.
- Several of these Christina Calvaneso and Steve Davis – went on to receive 21st Century Leaders Awards from UMass Amherst at graduations, an award that I nominated them.
- Two OIM CHC undergraduates, Emilio Alvarez-Flores and Karen Li, who also received a 21st Century leaders Award, have worked with Supernetwork Center Associates and have written theses and have had journal articles published.





Recent Funding – Envisioning a New Kind of Internet



We were one of five teams funded by the US National Science Foundation as part of the Future Internet Architecture (FIA) project. Our project: Network Innovation Through Choice envisions a new Internet architecture ChoiceNet received \$1,021,441.00 from 2011-2015.

Team:

- University of Massachusetts Amherst: Tilman Wolf, Anna Nagurney
- University of Kentucky: Jim Griffioen, Ken Calvert
- North Carolina State University: Rudra Dutta, George Rouskas
- RENCI/UNC: Ilya Baldin

Weaknesses of Current Internet and NSF EAGER Grant

- The Internet architecture lacks in mechanisms to introduce competition and market forces.
- Existing economic models cannot be deployed in today's Internet: no mechanisms in order to create and discover contracts with any provider and to do so on short-time scales, and time-scales of different lengths.
- Routing of messages may be inefficient and the capacity is not well-utilized in the network.

Additional funding to Tilman Wolf and me was provided by NSF for our EAGER: Collaborative Research: Enabling Economic Policies in Software-Defined Internet Exchange Points grant - \$149,992.00; 2015-2018.

Designing an Internet

The 2019 book by David Clark of MIT, a developer of the Internet, cites our paper:

"ChoiceNet: Toward an Economy Plane for the Internet," Wolf, Griffioen, Calvert, Dutta, Rouskas, Baldin, and Nagurney, ACM SIGCOMM Computer Communication Review 44(3) (2018), pp 58-65.



Center Associates



Center Associates



Research and Impact

Editorial Board Memberships

Since the founding of the Virtual Center for Supernetworks, Center Associates have served (or are serving) on multiple journal editorial boards including on such journals as: Production and Operations Management, Networks, Omega, Transportation Research E, Journal of Global Optimization, Optimization Letters, Annals of Operations Research, International Transactions in Operational Research, International Journal of Sustainable Transportation, Economics of Transportation, Computational Management Science, Computational Economics, and Netnomics.

This speaks to the reputation of the Center Associates in the scientific community.

Refereed Publications

Since the founding of the Center, over 150 journal articles and book chapters have been published and these, as preprints, are posted on the Supernetwork Center website. Below is a snapshot of the 2019 publications.



Journal Articles Receive Recognitions

Journal of Global Optimization (2016) 75:439-460 https://doi.org/10.1007/s10898-019-00794-x



Global supply chain networks and tariff rate quotas: equilibrium analysis with application to agricultural products

Anna Nagurney¹ O - Deniz Besik¹ - Ladimer S. Nagurney²

Received: 12 December 2018 / Accepted: 1 June 2019 / Published online 6 June 2019 © Springer Science+Business Media, LLC, part of Springer Nature 2019

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In this paper, we develop a global supply claim network model in which prefer maximizes in the requirement of the region comparison in the production and deliverships of production in the presence of the region o

Keywords Supply chains - Tariff rate quotas - Global trade - Networks - Variational inequalities - Agricultural products

1 Introduction

Global supply clasin networks, driven by profit-maximizing firms wishing to satisfy consumer dermand within and across national boundaries, have made possible the production and wide distribution of goods, as varied as food and other agricultural products to textiles and apparel as well as aluminum and steel. The global product flows associated with supply

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Production, Manufacturing and Logistics

Competitive food supply chain networks with application to fresh produce

Min Yu³, Anna Nagurney Abs

*Opportunat of Finance and Operations Stangerows, survivey School of Stangerows, University of Massachusetts, Ambert, SM 85001, United States

Arkir Jahry Beerhed 14 March 2012 Accessed 20 halt 2002

Available celler 3 August 28 Arywords Fred supply chains fred produce (Grandfeld commercial) ABSTRAC

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Today, food supply chains are complex, skital networks, creating parlyways from farms to consumers, involving production, proprogram distribution, and even the disposal of food (see Booklie. 1999; Van der Vorst, 2000; Anarryan et al., 2006; Monteiro, 2007: Trienekens and Zumbier, 2008: Abumada and Villalobos, 2009). Consumers' expectation of year-around availability of fresh food products has encouraged the globalization of food markets See Cook, 2002: Monteiro, 2007: Trienelone and Zuarbier, 2006: Aburnada and Villalobox, 2009). For instance, the United States in ranked number one as both importer and exporter in the internaof the \$15 billion alabel begicultural trade man a decade and (Cook, 2002), in the US alone, consumers now spend over 1.6 triflion dellars annually on food (Planker: Research, 2011). With growing slobal correctition (Abarrada and Villalobox, 2009), contribution along the chain (Boeblje, 1989; Cook, 2002) and, hence, new challenges for food supply chain modeling and management,

Tool supply chains are distinct from other product supply chains. The fundamental difference between find supply chains.

* Conceptualing author 4: Department of Phance and Operations Management, londing School of Management, Tollverdy of Manachusets, Amberts, MA 0.9000, Teleird Stone, Tel. v1 413 545 5005; fee: v1 413 543 3608.
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EST7-221.75 - see frust matter 0-2012 Ebevier B.V. All rights reserved. http://dx.doi.org/10.1016/j.ejoc.2012.07.002 and other supply chains in the centimons and significant chargein the quality of from products throughout the entire supply chains used the priors of fruit consumption (see Safer et al., 1965; Van der et al., 1922; This is repectably the case for fresh produce supply dation with accounting attention being placed on both finitions and safety. Couly, many consumers prefer the freshes produce and safety. Couly, many consumers prefer the freshes produce (2005; Monerow, ratinstite from the litteral disease Department of Agricultum (CEGN) (2011)) sugges that the consumption of both specialities in the consumption of the product of the consumption of the con

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Moreover, the flag persishabity of sof products has resulted in immerce food waterloos, further stressing food supply chains and the associated quality and purithfully. Seen food waterloos, and footnote are investable to food supply chain network likely (Herrprose, 2022; Widelse et al., 2005; Guistownees et al., 2011;). Hereover, it is intrinsed that approximately one third of the pixel food production is wasted on both arrangly (Guistownees or al., 2011;).

Journal Articles Receive Recognitions

Article co-authored with UMass Amherst Senior Vice Provost for Academic Affairs Dr. Tilman Wolf - *Notable Article in Computing, ACM Computing Reviews' Best of 2013.*



Books



Research Themes Over the Past 5 Years

The following are research themes that the Supernetwork Team has been researching over the past 5 years and will continue to do so.

- New Vision for the Internet and Business Models
- Cybersecurity and Infrastructure Security
- Network Paradoxes, including the Braess Paradox
- Healthcare Supply Chains, including Pharma and Blood Supply Chains
- Product Quality, including that of Food, and Perishability
- Tariffs, Quotas, and Trade Wars
- Sustainable Supply Chains
- Blockchains
- Humanitarian Logistics, Disaster Relief, and Refugee/Migration Networks.

Graphic of Some of the Applications



Additional Impact

Because of our expertise, we have given talks, and even courses, not only through Fulbright awards, but also at the World Bank, at a United Nations Office on Drugs and Crime workshop in DC, IBM Dublin, Raytheon, MITRE, United Technologies, and other organization/company venues.

The number of invited seminars given at colleges and universities around the globe exceeds 50 (including Harvard, MIT, University of Chicago, Brown University, Cornell University, University of Wisconsin, University of Michigan, CMU, University of Oklahoma, University of Alabama, Smith College, University of Memphis, St. Olaf College, WPI, Penn State, University of Buffalo, University of Catania in Italy, University of Gothenburg in Sweden, Vienna University of Economics and Business in Austria, Naval Academy in Colombia, etc.)

Outreach and Impact

The Supernetwork Sentinel



The Supernetwork Sentinel, the newsletter of the Virtual Center for Supernetworks, is produced three times a year. All 48 issues are posted online.

Social Media - Blog and Twitter





It 2004, I was recruited to be a Chaired Professor and to chair a department at another major research university.

I almost left UMass Amherst, but after receiving a counteroffer, and much thought, I decided to stay and to build from within. What I found missing, and was sorely needed, was to build greater synergy within programs and across schools and colleges.

With a great cohort of students, at that time, we started the UMass Amherst INFORMS Student Chapter, and its associated Speaker Series.

Many Doctoral Student Center Associates have served as Officers of this Student Chapter, and are very active members.



The Chapter has garnered 12 consecutive national awards for its activities, which includes a Speaker Series. I have had the pleasure of serving as the chapter's Faculty Advisor since its inception (over 15 years).

The Chapter has hosted renowned speakers from academia and industry (over 120 to-date), and students have acquired professional and leadership skills. The Chapter has started its own youtube channel with interviews with speakers posted.





Several of our former doctoral students (who are still Center Associates) having been recognized by INFORMS with **the Judith B. Liebman Award: Tina Wakolbinger, Qiang "Patrick" Qiang, and Amir H. Masoumi**.



50th Anniversary Isenberg PhD Celebration

Management Science PhD Alumni Panelists











Supernetwork Center Associates and Friends



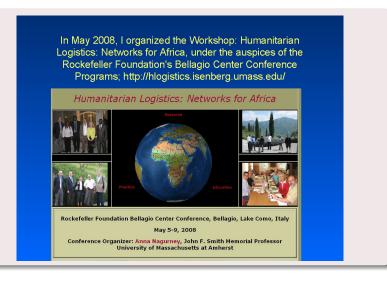
Workshops and Conferences Organized

- MKIDS Mini-Workshop, Supernetworks Laboratory for Computation and Visualization, Isenberg School of Management, University of Massachusetts, Amherst, September 10, 2003.
- Rockefellar Foundation Bellagio Center Team Residency, Lake Como, Italy, March 2004.
- Exploratory Seminary on Dynamic Networks at the Radcliffe Institute for Harvard University, Oct. 20-21, 2006.
- Fulbright Senior Specialist Award in Business Administration to Conduct Workshop on Complex Networks, University of Catania Italy, March 10-12, 2008.
- Rockefellar Foundation Bellagio Center Workshop: Humanitarian Logistics: Networks for Africa, Lake Como, Italy, May 5-9, 2008.
- First INFORMS Northeastern Regional Conference, UMass Amherst, May 6-7, 2011.

Workshops and Conferences Organized



Workshops and Conferences Organized



Workshops and Conferences Organized

- 2011 IEEE Conference on Supernetworks and System Management, Honorary Co-chair, Shanghai, China, May 29-30, 2011.
- Dynamics of Disasters: Harnessing the Science of Networks to Save Lives, AAAS Annual Meeting, Boston, Massachusetts, February 17, 2013.
- Workshop on Cybersecurity Risk Analysis for Enterprise Security, Sept. 19, 2014, at MITs Sloan School of Management (funded by ACSC).
- 2nd International Conference on Dynamics of Disasters, Kalamata, Greece, June 29-July 2, 2015.
- 3rd International Conference on Dynamics of Disasters, Kalamata, Greece, July 5-9, 2017 and 4th International Conference on Dynamics of Disasters, Kalamata, Greece, July 1-5, 2019.

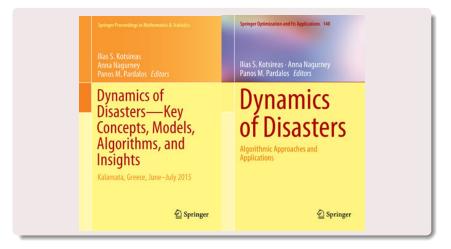
Workshops and Conferences Organized

Participants at Two Recent DOD Conferences in Greece



Workshops and Conferences Organized

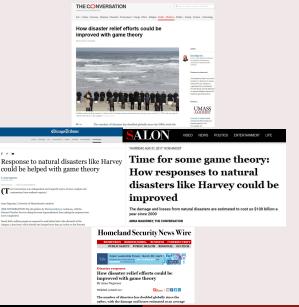
Edited Book Volumes



Writing OpEds

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Anna Nagurasy, University of Massachusetts Amberst

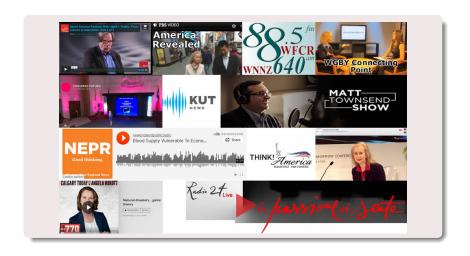


Enhanced Visibility

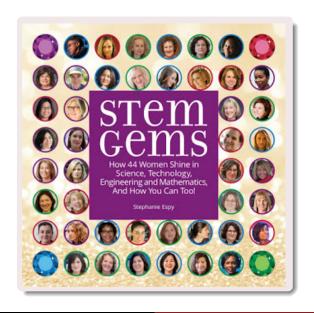
The visibility of our research/contributions has also garnered major invitations to serve as a panelist at the World Science Festival in NYC and also the New York Times Energy for Tomorrow event.



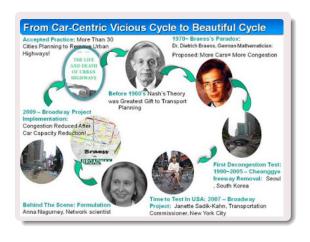
Coverage in the Media



Enhanced Visibility



Enhanced Visibility



Accolades

Accolades – Doctoral Student Center Associates' Isenberg and UMass Amherst Awards

- Tina Wakolbinger, now at the Vienna University of Economics and Business, received a UMass Amherst Graduate Fellowship Award, as did Patrick Qiang, now at Penn State.
- Dong "Michelle" Li, now at Babson, and Min Yu, now at the University of Portland, received an Isenberg Outstanding Doctoral Student Researcher Award.
- Sara Saberi, now at WPI, received an Isenberg Outstanding Doctoral Student Researcher Award and two Isenberg Scholar Awards.
- Shivani Shukla, now at the University of San Francisco, received an Isenberg Outstanding Doctoral Student Teaching Award.

Accolades – Doctoral Student Center Associates' Dissertation Awards

Dr. Patrick Qiang received the Charles V. Wootan Award from the Council of University Transportation Centers. His dissertation was titled: "Network Efficiency/Performance Measurement with Vulnerability and Robustness Analysis with Application to Critical Infrastructure."



Dr. Padma Ramanujam received the INFORMS Transportation Science Best Dissertation Award for her dissertation: "Transportation Network Policy Modeling for Congestion and Pollution Control: A Variational Inequality Approach."

Accolades - Honors and Awards

I have been elected a Fellow of the following societies: INFORMS, Network Science Society, and RSAI.

Recent other awards have included:

- 2018 Omega Rho Distinguished Lecturer of INFORMS
- 2019 Caratheodory Prize of the International Society of Global Optimization.



Accolades - Honors and Awards

- In 2020, I will be receiving the Harold Larnder Prize from CORS in Toronto, only the second female so honored in over thirty years.
- Also, I have been selected as the 2020 IFORS Distinguished Lecturer and will deliver my keynote talk at the CLAIO 2020 Conference in Madrid, Spain.

In 2019, I delivered keynote talks in Canada, Chile, France, Colombia, and Mexico, and, in 2020, will deliver keynote talks in France, Russia, and Spain (in addition to invited seminars at the University of Toronto and USC, among other universities).

Center Associates continue to garner honors and recognitions as well.

Accolades – Honors and Awards



Going Forward

Going Forward

- 20th Anniversary Celebration with a Symposium in September 2021, along with an edited proceedings volume
- Co-organizing the 5th International Conference on Dynamics of Disasters in Summer 2021 in Athens, Greece
- Continuing the momentum that we have established over the past few years with new PhD students and Center Associates
- Working with the UMass Amherst INFORMS Student Chapter to continue its Speaker Series and other activities
- Seeking additional funding to support activities through grants and development.

THANK YOU!



For more information, see: http://supernet.isenberg.umass.edu