Shrutivandana Sharma

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Research Interests

Decentralized decision and resource allocation in multi-agent systems; Network economics and games; Pricing and incentive provision in e-commerce applications; Procurement and supply-chain management; Energy markets; Mechanism design; Game theory

Teaching Interests

Mechanism design and game theory for networked systems; Queuing theory; Probability and stochastic processes; Linear and nonlinear programming; Stochastic control and dynamic programming; Pricing and incentive models for web applications; Computer and communication networks.

Education

University of Michigan (UM), Ann Arbor

- Ph.D., Electrical Engineering: Systems, December 2009
  Thesis title: "A mechanism design approach to decentralized resource allocation in wireless and large-scale networks: Realization and implementation"
  Advisor: Prof. Demosthenis Teneketzis, Electrical Engineering: Systems, UM, Ann Arbor

- Master of Science in Engineering, Electrical Engineering: Systems, April 2007
  GPA: 8.202/9.000 (Scale: A+ (9), A (8), A- (7), B+ (6), B (5))

Indian Institute of Technology (IIT), Kanpur

- Bachelor of Technology, Electrical Engineering, May 2004
  GPA: 9.5/10 (Scale: A (10), B (8), C (6), D (4), F (Fail)); Graduating rank: 2 in class of 80

Industry Experience

Yahoo! Research, Bangalore, India (December 2009 - present)

- Senior associate scientist in the advertising sciences group
  - Worked on pricing and allocation of display advertisements under various models
  - Developed a new model for display advertising to increase user traffic to advertisers
  - Analyzed advertiser and user satisfaction trade-off for ranking rules in sponsored search
  - Currently working on pricing and incentive issues in advertising through social networks

IBM T. J. Watson research center (Internship, Summer 2008)

- Worked on scalable resource management for IBM service management middleware
  - Developed a decentralized algorithm for allocating CPU (Central Processing Unit) computation power of web servers to optimize Quality of Service delivery to customers.

Publications

Journal papers

1) *"Local public good provision in networks: A Nash implementation mechanism"*
   S. Sharma and D. Teneketzis, under review in Games and Economic Behavior.

   Work on local public goods provision in exogenous directed networks where each user's actions (local public good) affect the utilities of a subset of network users. Each user knows only its own neighborhood in the network, its action space and utility are its private information, and it is selfish. We present a decentralized mechanism that is individually rational, results in budget balance at all Nash equilibria and off equilibrium, and implements in Nash equilibria the optimal centralized local public goods allocation.

2) *"A decentralized mechanism implementing in Nash equilibria the optimal centralized solution of a supply-chain problem"*
   S. Sharma, V. Babich, D. Teneketzis and M. Van Oyen, under review in Operations Research.

   Work on supply-chain coordination in the presence of multiple competitive suppliers and manufacturers. Each supplier's production capability and cost of production, and each manufacturer's value from the purchase of products is its private information. We present a decentralized negotiation mechanism that induces a game all of whose Nash equilibria result in optimal centralized trade of products.

3) *"A game-theoretic approach to decentralized optimal power allocation for cellular networks"*
   S. Sharma and D. Teneketzis, Telecommunication Systems, 2010.

   Work on power allocation for cellular uplink and downlink networks in the presence of interference and non-cooperative users whose utilities from power allocation are their private information. We present a power allocation and taxation mechanism that induces a game all of whose Nash equilibria result in optimal centralized power allocation.

4) *"Decentralized allocation of CPU computation power for web applications"*
   S. Sharma, A. Tantawi, M. Spreitzer and M. Steinder, Performance Evaluation, 2010.

   Work on allocation of CPU (Central Processing Unit) computation power of web servers to online applications with different service time requirements. We present a decentralized and scalable algorithm that converges to a CPU allocation that maximizes the net utility offered to all the applications.

5) *"An externalities-based decentralized optimal power allocation algorithm for wireless network"*
   S. Sharma and D. Teneketzis, IEEE/ACM Transactions on Networking, 2009.

   Work on power allocation for wireless networks in the presence of interference and decentralized network information. We present a decentralized power allocation algorithm that converges to optimal centralized power allocation if the users participate cooperatively.

6) *"Multicarrier on-off keying for fast frequency hopping multiple access systems in Rayleigh fading channels"*
   S. Sharma, G. Yadav and A. K. Chaturvedi, IEEE transaction on wireless communications, 2007.

Conference papers (peer reviewed)

7) *"A game-theoretic approach to decentralized optimal power allocation for cellular networks"*
S. Sharma and D. Teneketzis, Proceedings of GameComm, 2008.

8) *"An externality-based decentralized optimal power allocation scheme for wireless mesh networks"*
S. Sharma and D. Teneketzis, Proceedings of IEEE SECON, 2007.

Working papers

9) *"Resource allocation in local public good networks: A realization perspective"*
S. Sharma and D. Teneketzis, Available as Chapter 4 of my Ph.D. thesis.

Work on local public goods provision in exogenous directed networks where each user's actions (local public good) affect the utilities of a subset of network users. Each user knows only its own neighborhood in the network, and its action space and utility are its private information. We present a decentralized and scalable algorithm that obtains a local public goods allocation that maximizes the network-wide utility if all users participate cooperatively.

10) *"An analysis of efficiency-user satisfaction tradeoff for sponsored search"*
A. Gupta, S. Sharma and D. Garg

Work on analysis of tradeoff between efficiency (expected value of the ad slate to advertisers) and user satisfaction (Expected Reciprocal Rank of the ad slate) for a family of sponsored search ranking rules under the cascade model of user behavior. We characterize the above tradeoff and use that to propose guidelines for choosing an optimum (in terms of both efficiency and user satisfaction) ad ranking rule.

11) *"An algorithm for online allocation of display ads in the presence of user fatigue"*
K. Mukherjee, D. Garg and S. Sharma

Work on online display ad allocation to multiple streams of users where each advertiser has a net advertising budget. Because of user fatigue, an advertiser's bid (revealed online as users arrive) for a given user stream decreases with each ad impression. We present an algorithm for online ad allocation that achieves a competitive ratio of 1-1/e with respect to the revenue maximizing offline ad allocation when advertising budgets are large.

Talks

Invited talks

1) "A mechanism implementing in Nash equilibria the optimal solution of a supply-chain problem"
S. Sharma, V. Babich, M. Van Oyen and D. Teneketzis, *INFORMS annual meeting*, October 2008.

2) "Game theory and mechanism design based decentralized algorithms for power allocation in networks: cooperative and non-cooperative scenarios"
S. Sharma, D. Teneketzis, A. Tantawi, M. Spreitzer and M. Steinder,
Applied probability seminar, IBM T. J. Watson research center, August 2008.

3) "Externality-based decentralized optimal power allocation scheme for wireless mesh networks"
S. Sharma and D. Teneketzis

- *Department of Electrical and Computer Engineering, UC San Diego*, June 2007.
- *Department of Electrical Engineering, UC Los Angeles*, June 2007.

4) "Addressing resource allocation problems for communication networks using microeconomics"
S. Sharma, *Department of Electrical Engineering, IIT Kanpur, India*, August 2006.

Conference presentations

5) "Resource allocation in local public good networks: An implementation theory perspective"
   S. Sharma and D. Teneketzis

   – *Brazilian workshop of the Game Theory society*, University of Sao Paulo, Brazil, August 2010.
   – *STIET research workshop*, University of Michigan, Ann Arbor, May 2010.

6) "A game-theoretic approach to decentralized optimal power allocation for cellular networks"
   S. Sharma and D. Teneketzis, *GameComm*, Athens, Greece, October 2008.

7) "Decentralized allocation of CPU capacity for clustered web services"
   S. Sharma, *Service management middleware group, IBM Watson research center*, August 2008.

8) "Resource allocation in communication networks"
   S. Sharma, *Society of Women Engineers (SWE) national conference*, Nashville, October 2007.

9) "Externality-based decentralized optimal power allocation scheme for wireless mesh networks"
   S. Sharma and D. Teneketzis

   – *IEEE SECON,* San Diego, June 2007.
   – *NSF/CEME Decentralization Conference*, University of Michigan, Ann Arbor, April 2007.
   – *STIET research workshop*, University of Michigan, Ann Arbor, October 2006.

Teaching / Mentoring Experience

Graduate Student Instructor (GSI):

As a GSI of the following courses, I prepared and conducted recitations; set and graded quizzes/ exams/lab assignments; conducted labs; held office hours and maintained course websites.

- Probability & random processes (Graduate level)
  (i) EECS graduates (Fall 2005 & 2007), (ii) non-EECS graduates (Winter 2007).
- Signals & systems (Junior/Senior level), Fall 2006 & Winter 2009.
- Introduction to circuits (Freshmen/Sophomore level), Winter 2006.
- ❖ Received *Outstanding Student Instructor Award honorable mention* by American Society for Engineering Education, University of Michigan, Year 2005-06.

Graduate Student Mentor (GSM) – Winter 2007

- Conducted "preparing & delivering sections" and "active learning" workshops in GSI orientation.
- Mentored 25 GSIs in civil, aerospace, and atmospheric and oceanic engineering departments.
  - Did consultation for mentees about how they can conduct their GSI duties effectively.
  - Conducted classroom/lab observations and student surveys to give feedback on mentees' teaching.
- Participated in expert seminars on topics such as classroom diversity, academic integrity, best teaching practices, teaching problem solving, consultation, feedback and assessment.

Grant Writing Experience

- "Real-time communication, coordination and resource allocation in complex networked systems," D. Teneketzis and S. Sharma, submitted to AFOSR/NL (Systems and Networks).

Graduate course work

Static and Dynamic Optimization: Continuous optimization methods, Non-linear programming, Function space methods in system theory, Stochastic control, Matching mechanisms.

Stochastics: Probability & random processes, Stochastic processes, Statistical simulations & data analysis.

Economics: Advanced game theory, Microeconomics theory – I (Individual decision making), II (Game theory), III (Market and general equilibrium, market failure) and IV (Information economics and mechanism design), Public goods, Electronic commerce.

Operations management: Advanced topics in supply-chain.

Communication: Communication networks, Digital communication theory, Application of CDMA to cellular communication, Information and coding theory, Detection and estimation theory.

Research projects as part of course work

Project title	Course
• Competitive & cooperative inventory policies in a two-stage supply-chain	Supply chain mgmt.
• Priceline's Name Your Own Price system – analysis as a reverse auction from electronic-commerce perspective	Electronic commerce
• Common casting, Harvard-Radcliffe Dramatic Club – an analysis as a matching market	Matching mechanisms
• The dynamics of law clerk hiring: An experimental and computational investigation of proposals for reform of the market – a review	Matching mechanisms
• Dynamic team decision theory – an overview	Stochastic control
• Transformation of generic differentiable functions to convex functions: necessary and sufficient conditions	Non-linear programming
• Externalities in wireless communication: A public goods solution approach to power allocation	Public goods
• An intuitive understanding of throughput-delay trade off in ad hoc wireless networks	Communication networks
• Study of IEEE 802.15.3a physical layer proposals for Ultra Wide Band: Direct Sequence Ultra Wide Band & multiband Orthogonal Frequency Division Multiplexing proposals	Digital communication theory
• Multi Carrier On-Off Keying: A bandwidth efficient modulation scheme for Fast Frequency Hopping Multiple Access systems	B.Tech. project, IIT-Kanpur
• Bandwidth efficiency comparison of Frequency Hopping Code Division Multiple Access (FHCDMA) and Frequency Hopping M-ary Frequency Shift Keying (FHMFSK) incorporating multiuser detection	Application of CDMA to cellular communication

Seminar Participation

Socio Technical Infrastructure for Electronic Transactions (STIET):

STIET is a multi-disciplinary research program at UM consisting of School of Information, Electrical Engineering & Computer Science, Industrial Engineering & Operations Research, Economics and School of Business. The research focus of STIET is on Incentive Centered Design for internet and electronic commerce applications. From Fall 2005 to Winter 2009 I regularly participated in STIET's weekly seminar series and twice yearly research workshops.

Dynamic games reading group:

In Winter 2008 I participated in a group reading project with my advisor and four colleagues. We studied papers on dynamic games and discussed related research issues.

Awards / Honors

- Outstanding Student Instructor Award honorable mention by American Society for Engineering Education, University of Michigan, Year 2005-06
- Departmental fellowship, Electrical Engineering and Computer Sc., University of Michigan – September 2004 to August 2005
- Academic excellence award, IIT Kanpur – Year 2000-01 & 2002-03
- Phi Kappa Phi academic honor society member, UM chapter
- Eta-Kappa-Nu electrical engineering and computer science honor society member, UM Beta Epsilon chapter
- Tau-Beta-Pi engineering honor society member, UM Gamma chapter
- National scholar's honor society member
- Member: INFORMS (Institute for Operations Research and the Management Sciences)
- Member: IEEE (Institute of Electrical and Electronics Engineers)

Extra Curricular

Dance: "Bharatanatyam" (an Indian classical dance) artist and choreographer.

Community service: Volunteered in Tau-Beta-Pi and UM International Center community projects.

Counseling service: Served as freshmen student guide and student counselor at IIT Kanpur.

Skills

Computing skills

- Programming languages: C, Python, Matlab, Mathematica
- Systems simulation tool: Matlab simulink
- Operating systems: Windows, Linux, Mac

Language proficiency

- English & Hindi: Skilled in reading, writing and speaking
- Japanese: Basic conversation ability
- Sanskrit, Urdu & Bangla: Elementary knowledge