

INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

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Newsletters, Updates and preprints are available via

anonymous ftp: [ftp.ima.umn.edu](ftp://ftp.ima.umn.edu), www: <http://www.ima.umn.edu/>

The IMA was founded by and receives major support from the National Science Foundation.

IMA NEWSLETTER # 292

December 1–31, 2000

2000–2001 Program

MATHEMATICS IN MULTIMEDIA

See <http://www.ima.umn.edu/multimedia/> for a full description of the 2000–2001 Annual Program on Mathematics in Multimedia.

IMA schedules are subject to revision, particularly during workshops. See

<http://www.ima.umn.edu/~seminar/sched> and

<http://www.ima.umn.edu/newsltrs/> for the latest scheduling information.

News and Notes

<p>IMA “Hot Topics” Workshop:</p>
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<p>Mathematics of the Internet: E-Auction and Markets</p>
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<p>December 3-5, 2000</p>

<p>Organizers: John Birge (Northwestern University)</p>

<p>Brenda Dietrich (IBM T.J. Watson Research Center)</p>
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<p>Suzhou Huang (Ford Motor Company)</p>
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<p>Ennio Stacchetti (University of Michigan)</p>
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<p>Rakesh Vohra (Northwestern University)</p>

<p>with partial support by Ford, IBM,</p>

<p>and the University of Minnesota Office of Information Technology</p>

<p>See also http://www.ima.umn.edu/multimedia/fall/auction.html</p>

PARTICIPATING INSTITUTIONS: Centrum voor Wiskunde en Informatica, Consiglio Nazionale delle Ricerche, Georgia Institute of Technology, Indiana University, Iowa State University, Kent State University, Los Alamos National Laboratory, Michigan State University, Mississippi State University, Northern Illinois University, Ohio State University, Pennsylvania State University, Purdue University, Seoul National University (BK21 Math-SNU), Seoul National University (SRCCS), Texas A&M University, University of Chicago, University of Cincinnati, University of Houston, University of Illinois (Urbana), University of Iowa, University of Kentucky, University of Maryland, University of Michigan, University of Minnesota, University of Notre Dame, University of Pittsburgh, University of Wisconsin, Wayne State University.

PARTICIPATING CORPORATIONS: Ford, General Motors, Honeywell, IBM, Lockheed Martin, Lucent, Motorola, Schlumberger, Siemens, Telcordia Technologies, 3M.

Public Lecture:

The Other Side of the (e-Commerce) Fence

Robert Weber

Northwestern University

Monday, December 4, 2000, 7:00 pm

2650 Malcolm Moos Health Sciences Tower
515 Delaware Street, S.E.
University of Minnesota – East Bank

Free and Open to the Public

See also <http://www.ima.umn.edu/multimedia/fall/WeberLecture.html>

IMA Website

The IMA has a website which includes a great deal of information about its programs, past, present and future found at

<http://www.ima.umn.edu>

The site is constantly being updated. We encourage you to make use of this resource and recommend it to others who might be interested. We also invite comments or suggestions, which may be addressed to

webmaster@ima.umn.edu

In particular, we appreciate any information about World-Wide Web links appropriate to current and upcoming IMA programs.

Schedule for December 1–31, 2000

Friday, December 1

The 9:30 am IMA morning break will be in the IMA West Lounge, Vincent Hall 502

SEMINAR ON INDUSTRIAL PROBLEMS, 570 Vincent Hall

10:10 am

Kevin Kern
Avanti Corporation

Circuit Modeling

Not since AD 193, when the Roman empire was auctioned to the highest bidder has there been so much interest in auctions. The internet has done that. Many dot-coms have recently been established to facilitate transactions such as auctions, procurement, and bidding over the internet. Established “old-economy” companies have responded with a variety of marketplaces of their own, some of which involve joint-ventures between long-standing competitors. By having their store front on the internet, these market place can connect any buyer to any seller, offer products and services for sale in unprecedented variety and quantity. Business Week recently estimated that there may be as many as 600 companies that have been set up to connect buyers to sellers. They connect business to business, and business to sellers, providing a new, immense infrastructure for transactions.

While bidding and auction theory is a mature topic in economics, internet auctions and new markets offer the opportunity to put theory into practice as well as push the theory in new directions. For example, auctions where bidders care not only about what they get but what others get as well. Auctions where bidders care about price as well as other features like quality or reliability. Moving away from auctions to markets in general, there is the issue of price setting in markets involving indivisibilities of various kinds. For example, how does one match and execute buy offers that are contingent upon the execution of another different sell offer? Implementing auctions and markets with theoretically desirable properties sometimes raises thorny computational issues. How are these to be resolved?

Much of the existing literature on auctions restricts attention to the case where a single object is for sale. The internet provides new possibilities for using new auction formats and bidding mechanisms where multiple objects are sold simultaneously.

Mathematical topics arising from this area of research includes optimization, game theory, combinatorics, partial differential equations and simulation.

The three-day IMA workshop is intended to bring together leading researchers in economic theory of markets and auctions with applied mathematicians to discuss research in e-auction and markets. It is meant to encourage new collaborations that address these problems of significant intellectual and economic value. The workshop will include a set of overview lectures accessible to applied mathematicians, complemented by more technical talks on specific topics which emphasize the mathematical challenges posed by these problems.

Saturday, December 2

6:30–8:00 pm **Wine and Cheese Reception** Regent’s room, Radisson Metrodome Hotel

Sunday, December 3

All talks are in Lecture Hall EE/CS 3-180 unless otherwise noted.

9:00 am **Coffee and Registration** Reception Room EE/CS 3-176

9:20 am **Willard Miller, Fadil Santosa,
and Brenda Dietrich** Introduction

9:30 am **Rakesh V. Vohra**
Northwestern University Combinatorial Auctions: A Survey

Abstract: As the title suggests, its a survey. I will focus on the interplay between Integer Programming and Auction design. (Joint with Sven de Vries).

10:30 am **Break** Reception Room EE/CS 3-176

11:00 am–
12:00 pm **Michael H. Rothkopf**
Rutgers University Modeling Opportunities in Auctions

Abstract; This paper argues that the answers to interesting questions about real auctions depend, often critically, on the particular mathematical assumptions that go into a model of an auction situation. It then suggests some understudied

areas for fruitful mathematical research on competitive bidding. These include asymmetry, financially constrained bidders, complicated information structures, bidder decisions about auction participation, the effect of repeated auctions involving the same participants, auctioning items with interrelated values, and transaction costs. The paper also discusses two major areas where new, complicated auctions are being designed: combinatorial spectrum auctions and electricity and transmission rights auctions.

1:30 pm	Paul Milgrom Stanford University	Putting Auction Theory to Work: Ascending Auctions with Package Bidding
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Abstract: After reviewing the factors contributing to the present interest in new package bidding designs, a benchmark ascending auction with package bidding is described. If bidders bid straightforwardly at each round for the potentially most profitable package, the allocation converges to an approximately efficient one. Straightforward bidding is consistent with equilibrium when there are only two bidders and it is a best reply to straightforward bidding by other bidders for a bidder that wants to acquire all the items for sale. More generally, if others bid straightforwardly, then non-monotonicity in the prices over time create an incentive for bidders to delay making serious bids, increasing the time requirements and degrading the performance of the auction.

2:30 pm	Break	Reception Room EE/CS 3-176
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3:00 pm	John Ledyard California Institute of Technology	Optimal Mechanism Design for Internet Auctions
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4:00 pm	Break	Reception Room EE/CS 3-176
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4:30–5:30 pm	G. “Anand” Anandalingam University of Pennsylvania	Pricing of Multiple Services in Telecommunications Networks With Quality of Service Guarantees
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Abstract: We consider pricing of multiple services offered over a single telecommunications network. Each service has quality of service (QoS) requirements that are guaranteed to users. Service classes may be defined by the type of service, such as voice, video or data, as well as the origin and destination of the connection provided to the user. We formulate the optimal pricing problem as a mathematical program. We solve for both prices and resource allocations necessary to provide connections with guaranteed QoS, to serve the demand resulting from the prices. We derive optimality conditions and a solution method for this class of problems.

Joint with Neil J. Keon (Edwin L. Cox School of Business Southern Methodist University).

Monday, December 4

All talks are in Lecture Hall EE/CS 3-180 unless otherwise noted.

9:15 am	Coffee	Reception Room EE/CS 3-176
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9:30 am	Brenda Dietrich IBM T.J. Watson Research Center	Examples of Complex Marketplaces: Customers, Models and Solution Methods
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Abstract: We discuss three classes of complex marketplaces: direct procurement, indivisible supply/demand, and combinatorial bids with type constraints. For each, we describe the commerce environment, the mathematical models and the solution methods.

In weekly direct procurement, suppliers submit bundled bids for multiple commodities. The goal is to select a minimum cost set of bids that meet all requirements while satisfying additional constraints such as a minimum number of suppliers for each commodity and maximum number of suppliers.

Certain commodities such as steel and paper need to be sourced from a single supplier; a bid for a 2 feet wide galvanized coil cannot be satisfied by two 1 foot wide coils. The introduction of such indivisibility constraints makes the problem of finding the set of winning bids and asks NP-hard and can be modeled as a generalized assignment problem.

Based on a liability limiting constraint proposed by the FCC for its license auction, we formulate a more general type-based bidding system for combinatorial auctions, and discuss a column generation approach for solving such auctions.

Joint work with Jayant Kalagnanam.

10:30 am	Break	Reception Room EE/CS 3-176
11:00 am– 12:00 pm	Jeff Kephart IBM T.J. Watson Research Center	TBA
1:30 pm	Suzhou Huang Ford Motor Company	Pricebot Dynamics

Abstract: We study a class of dynamic pricing duopoly games that model the type of environment in which e-commerce will be carried out in not so distant future. Under Markov settings these games can be solved via backward induction. The equilibrium structure is found to display very complex patterns when parameters of the model are varied, due to bifurcation phenomena in the discrete map induced by backward induction. However, it is possible to define an effective but simpler dynamics that retains the optimality of the original game in the long run. We further show that this effective dynamics can be sustained by steady self-confirming equilibria. Our results (1) set limits on what learning algorithms based on Markov assumptions can obtain and (2) imply that learning in this kind of games should not be focused on the exact reaction functions, but rather on achieving optimal net present values with the realized time series of prices.

2:30 pm	Break	Reception Room EE/CS 3-176
3:00 pm	Alvin E. Roth Harvard University	Last Minute Bidding and the Rules for Ending Second Price Auctions: Theory and Evidence from a Natural Experiment on the Internet

Abstract: An important issue in auction design concerns the rules governing the end of the auction. The internet auctions conducted by eBay and Amazon present a natural experiment because they use different rules for ending an auction. Auctions on eBay have a fixed end time, while auctions on Amazon, which operate under otherwise similar rules, do not have a fixed end time, but continue if necessary past the scheduled end time until ten minutes have passed without a bid. The strategic differences in the auction rules are reflected in the auction data by significantly more late bidding on eBay than on Amazon. Furthermore, more experienced bidders on eBay submit late bids more often than do less experienced bidders, while the effect of experience on Amazon goes in the opposite direction. On eBay, there is also more late bidding for antiques than for computers. We also find scale independence in the distribution over time of bidders' last bids, of a form strikingly similar to the 'deadline effect' noted in bargaining: last bids are distributed according to a power law. Both the theory and the data suggest that multiple causes contribute to late bidding, with strategic issues related to the rules about ending the auction playing an important role.

Joint work with Axel Ockenfels.

4:00 pm	Discussion
5:00–6:30 pm	Reception

Public Lecture:

The Other Side of the (e-Commerce) Fence

Robert Weber
(Northwestern University)

Monday, December 4, 2000, 7:00 pm

2650 Malcolm Moos Health Sciences Tower
515 Delaware Street, S.E.
University of Minnesota – East Bank

Free and Open to the Public

Economic markets occasionally fail to work as intended. Sometimes the problem is less-than-rational behavior on the part of market participants. At other times participants, individually or collectively, are more rational than the market organizers anticipate, and, legally or otherwise, find ways to subvert a market to their own ends. Those seeking to build e-commerce marketplaces must take care to look at their systems through the eyes of those who will be players in the market.

Tuesday, December 5

All talks are in Lecture Hall EE/CS 3-180 unless otherwise noted.

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| 8:45 am | Coffee | Reception Room EE/CS 3-176 |
| 9:00 am | Garrett van Ryzin
Columbia University | Airline Revenue Management and e-Markets |

Abstract: Revenue (or yield) management uses applied mathematical methods to intelligently control the availability of price discounts. While the practice in airlines predates the internet by several decades, it shares some common features with dynamic pricing in e-markets. Moreover, airline tickets are among the highest volume consumer products sold through new e-commerce pricing mechanisms. Thus, a convergence of these two developments appears to be well underway. In this talk, we discuss the traditional revenue management problem and survey the mathematical models and algorithms that have been developed in this area. We then examine the impact of e-market innovations such as Priceline.com's guaranteed purchase contracts, ticket auctions, etc. on the practice of revenue management. While some have suggested that auctions and similar innovations will completely replace traditional price mechanisms, a melding of new and old looks more likely. We discuss the research challenges that arise from this integration.

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| 10:00 am | John Birge
Northwestern University | Equilibria in Electric Power Exchange Auction Markets |
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Abstract: Deregulated electric power markets have been increasingly transformed into auction clearing houses. We will describe the structure of these markets and the forms of equilibria that can exist. We will give characterizations of equilibria in simple stylized markets and illustrate conditions that produce apparent paradoxes such as declining prices during periods of high demand. We will also discuss some experience with the market in Colombia and the difficulties in using pure optimization procedures in predicting auction behavior or devising bidding strategies.

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| 11:00 am | Break | Reception Room EE/CS 3-176 |
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11:30 am–
12:30 pm

Chris Caplice
Logistics.com

TBA

Wednesday, December 6

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400

Thursday, December 7

The 10:30 am IMA morning break will be in the IMA West Lounge, Vincent Hall 502

**School of Math Applied Mathematics and Numerical Analysis Seminar
IMA West Seminar Room, Vincent Hall 570**

11:15 am

Jianliang Qian
IMA

Paraxial Eikonal Solvers for Anisotropic quasi-P Travel-times

Abstract: The first-arrival quasi-P wave travelttime field in an anisotropic elastic solid solves a first-order nonlinear partial differential equation, the qP eikonal equation. The solution of the **paraxial** qP eikonal equation, an evolution equation in depth, gives the first-arrival travelttime along downward propagating rays. We illustrate that the downward propagating quasi-P wave need not correspond to the travelttime gradient of positive third component. We devise nonlinear numerical algorithms to compute the paraxial Hamiltonian for quasi-P wave propagation in general anisotropic media. A second-order upwind finite-difference scheme solves this paraxial eikonal equation in $O(N)$ floating point operations, where N is the number of grid points. Numerical experiments on 2-D transversely isotropic models with inclined symmetry axes demonstrate the accuracy of the algorithms.

This is a joint work with Prof. William W. Symes of Dept. Computational and Applied Mathematics, Rice University.

See <http://www/math.umn.edu/~reitich/seminar.html> for further information.

Jianliang Qian (IMA)

Title: Paraxial eikonal solvers for anisotropic quasi-P traveltimes

Abstract:

Friday, December 8

The 9:30 am IMA morning break will be in the IMA West Lounge, Vincent Hall 502

SEMINAR ON INDUSTRIAL PROBLEMS, 570 Vincent Hall

10:10 am

Benjamin Eggleton
Lucent

Fiber Devices Drive the Optical Networking Revolution

Abstract: An emerging class of fiber waveguide structures is being used to increase the functionality of fiber devices, enabling new optical components critical to the performance of next generation lightwave networks. These devices rely on advances in the fabrication of optical fiber waveguides, which go beyond the conventional silica design and fall into two general categories: 1) fibers drawn with modified claddings that include non-silica regions throughout their length, examples include photonic crystal fibers; and 2) local modifications to the waveguide after fabrication, examples include fiber devices that incorporate thin film electrodes integrated into the cladding region for efficient thermal actuation. Design and optimization of these type of complex waveguide devices relies on an assortment of sophisticated and often clumsy modeling tools, including modeling of waveguide properties (e.g. photonic bandgap calculations), heat-flow dynamics in thermally actuated fiber devices, simulations of grating devices using coupled mode equations, and finally, simulations that

9:00–11:00 am **IMA Industrial Postdoc Seminar**
 IMA West Seminar Room
 Vincent Hall 570

Progress reports by industrial postdocs on their projects followed by discussion among participants.
 The seminar is directed by Fadil Santosa. Those who wish to attend are asked to contact Professor Santosa.

Wednesday, December 20 - Friday December 22

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400 Wednesday and Thursday and in the IMA West Lounge, Vincent Hall 502 on Friday.

Monday, December 25

Christmas, A University of Minnesota holiday. The IMA offices will be closed.

Tuesday, December 26

University of Minnesota holiday. The IMA offices will be closed.

Wednesday, December 27 - Friday December 29

The 10:30 am IMA morning break will be at the IMA East in Lind Hall 400 Wednesday and Thursday and in the IMA West Lounge, Vincent Hall 502 on Friday.

CURRENT IMA PARTICIPANTS

POSTDOCTORAL MEMBERS FOR 2000-2001 PROGRAM YEAR

NAME	PREVIOUS INSTITUTION
ARMENDARIZ, JAVIER	Northwestern University
BETELU, SANTIAGO	Univ. Nacional del Centro de la Prov. de Buenos Aires
CARTER, JAMYLLÉ	UCLA
CHENG, LI-TIEN	UCLA
EFENDIEV, YALCHIN	California Institute of Technology
ESEDOGLU, SELIM	Courant Institute of Mathematical Sciences
HAN, BIN	Princeton University
HAWA, TAKUMI	Rensselaer Polytechnic Institute
KIM, YONG	University of Wisconsin
NOVIKOV, ALEXEI	Stanford University
QIAN, JIANLIANG	Rice University

POSTDOCTORAL MEMBERSHIPS IN INDUSTRIAL MATHEMATICS

NAME	PREVIOUS INSTITUTION	INDUSTRIAL AFFILIATION
CHENG, CHRISTINE	Johns Hopkins University	Telcordia Technologies
GOPALAKRISHNAN, JAY	Texas A& M University	Medtronic
KIRILL, DIMITRI	Northwestern University	Motorola
NIGAM, NILIMA	University of Delaware	Seagate

VISITORS IN RESIDENCE (as of 15 November 2000)

AFECHÉ, PHILIPP	Northwestern University	DEC 3 - 5
ALLEN, BETH	University of Minnesota	DEC 3 - 5
ANANDALINGAM, G.	University of Maryland	DEC 2 - 5
BIKHCHANDANI, SUSHIL	University of California Los Angeles	DEC 2 - 5
BIRGE, JOHN	Northwestern University	DEC 2 - 5
BISWAS, SHANTANU	Indian Institute of Science	DEC 1 - 7
BRUCKSTEIN, ALFRED	Technion	SEP 1 - DEC 31
CAPLICE, CHRIS	Logistics.com	DEC 2 - 5
CASE, JAMES	SIAM	DEC 2 - 5
CHENG, CHRISTINE	Johns Hopkins University	SEP 1 - AUG 31
CHENG, LI-TIEN	Institute for Mathematics and its Applica	SEP 1 - DEC 15
CIPRA, BARRY		SEP 1 - AUG 31
COCKBURN, BERNARDO	University of Minnesota	SEP 1 - AUG 31
CRISTINI, VITTORIO	University of Minnesota	SEP 1 - MAY 31
DIETRICH, BRENDA	IBM T.J. Watson Research Center	DEC 2 - 5
DULLES, FRED	IMA	SEP 1 - AUG 31
EGGLETON, BENJAMIN	Lucent Technologies	DEC 7 - 8
EKHAUS, MICHAEL	Gibraltar Analytics	DEC 3 - 5
ELMAGHRABY, WEDAD	Georgia Institute of Technology	DEC 2 - 6
ESO, MARTA	IBM Research Division	DEC 2 - 5
ESO, PETER	Northwestern University	DEC 2 - 5
FANG, LIPING	Ryerson Polytechnic University	DEC 2 - 6
GALLIEN, JEREMIE	Neoptis, Inc.	DEC 2 - 5
GARRETT, PAUL	University of Minnesota	SEP 1 - AUG 31
GULER, KEMAL	Hewlett Packard Laboratories	DEC 2 - 5
GULLIVER, ROBERT	University of Minnesota	SEP 1 - AUG 31
HOFFMAN, JOHN	Lockheed Martin	SEP 1 - AUG 31
HORSTMANN, DIRK	Universitat zu Koeln	AUG 21 - MAR 31
HUANG, SUZHOU	Ford Motor Company	DEC 2 - 5
HURWICZ, LEONID	University of Minnesota	DEC 2 - 5
INTERRANTE, VICTORIA	University of Minnesota	SEP 1 - JUN 30
JAIN, SHAIENDRA	Hewlett-Packard Laboratories	DEC 2 - 5
KAMESHWARAN, S.	Indian Institute fo Science	DEC 1 - 7
KATOK, ELENA	Pennsylvania State University	DEC 2 - 5
KEKINOCÁK, PINAR	Georgia Institute of Technology	DEC 2 - 5
KEPHART, JEFF	IBM T.J. Watson Research Center	DEC 2 - 5
KERNS, KEVIN	Avanti Corporation	NOV 30 - DEC 1
KESKINOCÁK, PINAR	Georgia Institute of Technology	DEC 2 - 4
KHUDANPUR, SANJEEV	Johns Hopkins University	SEP 9 - DEC 9
KUTANOGLU, ERHAN	University of Arkansas	DEC 2 - 5
LA POUTRE, HAN	CWI	DEC 2 - 6
LANNING, STEVEN	Aerie Networks	DEC 2 - 5
LEDYARD, JOHN	California Institute of Technology	DEC 2 - 5
LEDYARD, MEG	University of Minnesota	DEC 3 - 5
LI, JENNY	Penn State University	DEC 2 - 5
LYUBEZNIK, GENNADY	University of Minnesota	SEP 1 - AUG 31
MEUNIER, LUDOVIC	Ecole Polytechnique	NOV 6 - DEC 23
MILGROM, PAUL	Stanford University	DEC 2 - 5
MILLER, WILLARD	Institute for Mathematics & its Applicati	SEP 1 - AUG 31
MONMA, CLYDE	Telcordia Technologies	DEC 2 - 6
ODLYZKO, ANDREW	AT&T Labs - Research	DEC 1 - 5
ODYNIEC, MICHAL		DEC 6 - 9
OLVER, PETER	University of Minnesota	SEP 1 - AUG 31
PARKES, DAVID	University of Pennsylvania	DEC 2 - 5

QIAN, JIANLIANG	Institute for Mathematics and its Applica	AUG 8 - 31
RAGHAVAN, S.	University of Maryland, College Park	DEC 2 - 5
ROTH, ALVIN	Harvard University	DEC 2 - 5
ROTHKOPF, MICHAEL	Rutgers University	DEC 2 - 5
SALMEEN, IRV	Ford Motor Company	DEC 2 - 5
SANTOSA, FADIL	IMA and MCIM	SEP 1 - AUG 31
SCHULZ, ANDREAS	Massachusetts Institute of Technology	DEC 2 - 5
SCHUMMER, JAMES	Northwestern University	DEC 2 - 4
SHEN, JACKIE	University of Minnesota	SEP 1 - JUN 30
SIMPSON, STEPHEN	Penn State University	DEC 2 - 5
SVERAK, VLADIMIR	University of Minnesota	SEP 1 - AUG 31
TELLO, JOSE IGNACIO	Universidad Complutense de Madrid	SEP 18 - DEC 22
THAYER, FRANCISCO JAVIER	MITRE Corporation	SEP 1 - AUG 31
TOMAK, KEREM	University of Texas at Austin	DEC 2 - 4
TUPPER, PAUL	Stanford University	SEP 1 - DEC 31
VAN RYZIN, GARRETT	Columbia University	DEC 2 - 5
VERMA, ARUN	Cornell University	DEC 2 - 5
VOHRA, RAKESH	Northwestern University	DEC 2 - 5
VULCANO, GUSTAVO	Columbia Business School	DEC 2 - 5
WANG, LAN	Ford Motor Company	DEC 2 - 5
WEBER, ROBERT	Northwestern University	DEC 2 - 5
WEIN, LARRY	Massachusetts Institute of Technology	DEC 2 - 5
WELLMAN, MICHAEL	University of Michigan	DEC 2 - 5
YANG, YONG	Ford Motor Company	DEC 2 - 5
ZAJIC, TIM	Lockheed Martin	SEP 1 - AUG 31
ZANZOTTO, GIOVANNI	University of Padua	NOV 17 - DEC 18

See also URL: <http://www.ima.umn.edu/people/>