INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS

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IMA NEWSLETTER # 312

September 1–September 30, 2002

2002–2003 Program

OPTIMIZATION

See http://www.ima.umn.edu/optimization/ for a full description of the 2002–2003 program on Optimization.

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.

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PART I: NEWS AND NOTES

Delaware joins IMA as a Participating Institution

The University of Delaware, in Newark, Delaware, has joined the IMA as a Participating Institution. For information on the benefits of becoming a Participating Institution at the IMA, point to http://www.ima.umn.edu/pidescription.html. For more information about the University of Delaware math department, point to http://www.math.udel.edu/.

Doug Arnold gives Plenary Lecture at the ICM

On 24 August, the IMA Director, Doug Arnold, gave a plenary address to the 2002 International Congress of Mathematicians, in Beijing. His talk was titled, “From exact sequences to colliding black holes: Differential complexes in numerical analysis”.

IMA New Associate Director

Scot Adams will succeed Bob Gulliver as Associate Director of the IMA, beginning 1 September 2002. The position has a three-year term.

IMA Tutorial:

Supply Chain and Logistics Optimization

September 9–13, 2002
Organizers: Cynthia Barnhart (Civil and Environmental Engineering Department, MIT), Michael Juenger (Institut fuer Mathematik, Universitaet zu Koeln), and David Simchi-Levi (Engineering Systems, MIT)

See http://www.ima.umn.edu/optimization/fall/t1.html

IMA Workshop:

The Role of Optimization in Supply Chain Management

September 23-27, 2002
Organizers: Brenda Dietrich (Mathematical Sciences, IBM T.J. Watson Research Center), George Nemhauser (Georgia Institute of Technology), and David Simchi-Levi (Engineering Systems, Massachusetts Institute of Technology)

See http://www.ima.umn.edu/optimization/fall/op1.html

IMA "Hot Topics" Workshop:

Operational Modeling and Biodefense: Problems, Techniques, and Opportunities

September 28, 2002
Organizers: Douglas N. Arnold (Director, IMA), Mac Hyman (Los Alamos National Laboratory), Edward H. Kaplan (Management Sciences, Yale University)

Cosponsored with the Society for Industrial and Applied Mathematics (SIAM) and with additional support from the University of Minnesota Consortium on Law and Values in Health, Environment & the Life Sciences.

See http://www.ima.umn.edu/optimization/fall/biodefense.html

IMA 2002-03 PROGRAM: OPTIMIZATION

Mathematical Optimization is experiencing substantial advances. There have been remarkable developments in the underlying methods – for example: $(*)$ the emergence of interior methods for both linear and nonlinear optimization problems, $(*)$ the rediscovery of *cuts* as an effective tool for solving general integer programs, as well as for structured problems, and $(*)$ the emergence of new disciplines

such as positive semidefinite programming which attack a broad variety of discrete and continuous problems. The problems being studied have grown rapidly and the computing platforms are increasing in power by orders of magnitude. This is an excellent time for the consolidation and advancement in this field as the focus of an IMA Special year.

The year is broken into three quarters, each focusing on a different topic. The fall quarter is almost complete and has focused on the rapidly evolving area of supply chain, transportation and logistics optimization, as well as advances in integer programming.

The winter quarter will focus on advances in the underlying methods dealing with both nonlinear and linear optimization. Specific focus areas will include semidefinite programming, computational differentiation and nonconvex optimization.

The spring quarter will deal with the connections between optimization and information technology, an area that is proving to be increasingly important, and which will substantially benefit from a period of focus. This includes areas of discrete mathematics as well as areas such as network design and optimization.

We plan to hold a one-week introductory workshop at the beginning of the year, for the particular benefit of the optimization year postdocs. This will provide an overview of the state of the art in the underlying mathematical disciplines, and should provide a basis for much of the years activities. In addition, we will hold shorter tutorial workshops as needed during the three semesters.

IMA Website

Comments or suggestions concerning the IMA website 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.

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PART II: SCHEDULE FOR SEPTEMBER 1–SEPTEMBER 30, 2002

Monday, September 2

Labor Day, a University of Minnesota holiday. IMA offices will be closed.

Tuesday, September 3

The 10:30 IMA break will be in Lind Hall 400.

Wednesday, September 4

The 10:30 IMA break will be in Lind Hall 400.

Thursday, September 5

10:15 am	**Orientation** For postdocs and visitors	Lind 400

Friday, September 6

The 10:30 IMA break will be in Lind Hall 400.

Monday, September 9

IMA Tutorial:

Supply Chain and Logistics Optimization

September 9–13, 2002
Organizers: Cynthia Barnhart (Civil and Environmental Engineering Department, MIT), Michael Juenger (Institut fuer Mathematik, Universitaet zu Koeln), and David Simchi-Levi (Engineering Systems, MIT)

See http://www.ima.umn.edu/optimization/fall/t1.html

¿From September 9-13, 2002, we will hold a five-day tutorial workshop as an introduction to the IMA thematic year on Optimization and, especially, the fall quarter on Supply Chain and Logistics Optimization. The tutorial will provide an overview of the state of the art in the underlying mathematical disciplines and their application to supply chain and logistics. Topics include linear programming, integer programming, stochastic optimization, combinatorial optimization, and supply chain optimization. Issues addressed include supply chain design, production, inventory and transportation coordination, pricing and yield management, and vehicle routing problems. Hands-on computing experience (using AMPL and ILOG) will be provided to illustrate these methodologies and modeling concepts. Several important applications will be explored, including vehicle routing and scheduling, dynamic pricing, and service parts logistics.

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

Note that the talks will be in "two" 45 minute intervals, separated by a 15 minute break.

8:30 am	**Coffee and Registration**	Reception Room EE/CS 3-176
9:15 am	**Douglas N. Arnold, Scot Adams, and Organizers**	Welcome and Introduction
9:30–11:15	**Daniel Bienstock** Columbia University	Large-Scale Linear Programming

Abstract: Linear Programming is the central tool of Mathematical Programming. Linear programming models are flexible enough to adequately describe many realistic problems arising in modern industrial settings, while at the same time taking advantage of the considerable expertise on computational linear algebra that has been developed during the last fifty years. As a result, linear programming models are abundantly used in logistics, transportation, finance and many other practical applications.

Linear Programming has undergone profound changes during the last twenty years, resulting in codes that are thousands (and sometimes, millions) of times faster than what was available just fifteen years ago. Yet difficult challenges persist, in the form of large-scale linear programming problems arising in routing, network design, chip design and other settings. In fact, large problem instances render even the best of codes nearly unusable.

In this lecture we will survey fundamentals of Linear Programming theory, with special emphasis on recent developments, and in particular, on techniques geared to handling very large instances.

10:15–10:30	**Coffee Break**	EE/CS 3-176
2:30–4:15	**Robert Fourer** Northwestern University	AMPL hands-on session

Abstract: Modeling languages describe optimization problems to computer systems in the symbolic terms familiar to people, rather than in the obscure input forms convenient to optimizing algorithms. In typical use, a symbolic model and specific data are automatically translated to a problem instance and submitted a solver; subsequent results are automatically retrieved and translated back to forms convenient for inspection and analysis. A single modeling language can be interfaced to many solvers, providing access to techniques for a range of linear, nonlinear, and discrete problems, and encouraging comparisons between alternative algorithms for individual problem types.

This session will provide an introduction to AMPL, one of the more widely used optimization modeling languages, through a series of simple linear and integer programming models. Participants will have a chance to experiment with AMPL models and to ask how a modeling language might be applied to problems of special interest to them.

3:15–3:30	**Coffee Break**	EE/CS 3-176
4:15 pm	**IMA Tea/Reception**	IMA East, 400 Lind Hall

A variety of appetizers and beverages will be served.

Tuesday, September 10

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

9:00	**Coffee**	EE/CS 3-176
9:30–11:15	**John R. Birge** Northwestern University	Stochastic Optimization

Abstract: Supply chain and logistics problems inevitably involve the consideration of random quantities such as uncertain demands, supplies, travel times, costs and prices. This tutorial will present some fundamental stochastic optimization models to include such random events. The models will include decisions for network design, capacity, vehicle flows, and contract terms. We will then present a general framework for these stochastic optimization problems, their basic properties, algorithms, and solutions. The discussion will focus on discrete-time models but will also introduce continuous-time models and real-option approaches to deal with financial issues in supply chains and logistics.

10:15–10:30	**Coffee Break**	EE/CS 3-176
2:30–4:15	**E. Andrew Boyd** PROS Revenue Management	Dynamic Pricing and Revenue Management
3:15–3:30	**Coffee Break**	EE/CS 3-176

Wednesday, September 11

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

9:00	**Coffee**	EE/CS 3-176
9:30–11:15	**Andrew Miller** University of Wisconsin, Madison	Integer Programming

Abstract: This tutorial is about the theory and algorithms for solving mixed-integer programming problems. We will focus on the recent LP-based methodologies of branch-and-cut and branch-and-price, which are the techniques that make it possible to solve large-scale problems, but we will use discuss briefly some other methods such as basis reduction, heuristics, and Lagrangian duality.

10:15–10:30	**Coffee Break**	EE/CS 3-176
2:30–4:15	**Martin W.P. Savelsbergh** Georgia Institute of Technology	Vehicle Routing & Scheduling Tutorial

Abstract: This tutorial is about models and algorithms for solving vehicle routing and scheduling problems. We will cover heuristic as well as optimization techniques. We will demonstrate the use of these techniques in two practical applications: vendor managed inventory resupply and linehaul scheduling.

3:15–3:30	**Coffee Break**	EE/CS 3-176

Thursday, September 12

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

9:00	**Coffee**	EE/CS 3-176
9:30–11:15	**Martin Skutella** Sloan School of Management (MIT)	Flows Over Time

Abstract: The intention of the tutorial is to give an introduction into the area of ”flows over time” or dynamic flows”. Flows over time have been introduced about forty years ago by Ford and Fulkerson and have many real-world applications such as, for example, traffic control, evacuation plans, production systems, communication networks, and financial flows. Flows over time are modelled in networks with capacities and transit times on the arcs. The transit time of an arc specifies the amount of time it takes for flow to travel from the tail to the head of that arc. In contrast to the classical case of static flows, a flow over time specifies a flow rate entering an arc for each point in time and the capacity of an arc limits the rate of flow into the arc at each point in time. The topics covered range from the classical results of Ford and Fulkerson on maximal s-t-flows over time to very recent approximation results for flows over time with multiple commodities and costs.

10:15–10:30	**Coffee Break**	EE/CS 3-176
2:30–4:15	**Gregory Glockner** ILOG	Discovering Combinatorial Optimization with the ILOG Optimization Suite

Abstract: ILOG is the world leader in optimization technology, supplying the world's most powerful and comprehensive components for developing optimization applications. With core algorithms from mathematical programming and constraint programming, the ILOG Optimization Suite is highly effective at solving industrial and research problems in constraint satisfaction and optimization. The ILOG Optimization Suite powers the leading software for supply chain management and logistics optimization.

In this tutorial, we will use a rapid development system to explore basic combinatorial optimization problems. The sample problems will illustrate powerful techniques like constraint propagation and iterative optimization, which are invaluable to solving real-world optimization applications in supply chain and logistics. The tutorial will emphasize hands-on examples and their relationship to larger applications.

3:15–3:30	**Coffee Break**	EE/CS 3-176

APPL. MATH. AND NUM. ANAL. SEMINAR, Vincent Hall 570:

3:30pm	**Fernando Reitich** Univ. of Minnesota	Shape deformations and analytic continuation in free boundary problems

In this talk I will present a general approach to the analysis of steady states and nonlinear stability for a class of free-boundary problems. The approach is based on the explicit consideration of series solutions in a parameter measuring variations of domains (e.g. steady state or initial configurations) from separable geometries (e.g. planes, spheres, etc). The method relies on the derivation of formulas for the recursive evaluation of (Taylor) approximations of arbitrary order in the variation parameters, and on the iterative estimation of the growth, in appropriately defined spaces, of the resulting functional coefficients. We shall present a variety of instances where this procedure leads to general results on analyticity of solutions, on existence of complex steady states and on nonlinear stability of equilibria. Particular attention will be given to examples of "curvature driven" free-boundary problems, including the classical Stefan problems, models of capillary fluid drops, water waves, tumor growth, etc. We shall further show that the relevance of our studies goes beyond the theoretical, as it uncovered the mechanism behind the observed performance of a class of numerical algorithms, based on shape-perturbation theory, that have been used in these and other contexts. Indeed, our research shows that the standard implementations of these schemes can suffer from severe ill-conditioning as a result of pronounced cancellations in the underlying recursions. Moreover, our work further suggests alternative implementations with greatly improved properties of numerical stability and convergence, enhanced by methods of analytic continuation. As we shall demonstrate these modifications can have a dramatic effect on the accuracy and applicability of perturbative numerical approaches to (boundary value and) free-boundary problems.

6:00 pm	**Tutorial Dinner**	Mangia restaurant, 1501 University Ave. S.E.

Friday, September 13

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

9:00	**Coffee**	EE/CS 3-176
9:30–11:15	**Jon Lee** IBM T.J. Watson Research Center	Service Parts Logistics

Abstract: Large spare-parts inventory and distribution logistics operations involve over 10K part numbers, with annual volume in the several M. In recent years, market forces have changed the way these services are sold and delivered. These changes are being made to address the needs to improve customer satisfaction and to drive down costs associated with service delivery. For example, the IBM/ITS North American maintenance organization focused on specific areas in order for IBM to drive down costs and improve the customer experience. Specifically, (i) a value-based pricing scheme tied to service levels, and (ii) a call screening process enabling remote diagnosis of problems. These changes led to challenging logistics requirements involving the deployment of labor and parts in order to satisfy contracted service levels while containing inventory and transportation costs.

The Optimization Center of the Mathematical Sciences Department at IBM Research and IBM's ITS/SPS organization, in collaboration with the Lehigh University Department of Industrial and Manufacturing Engineering have been developing a next generation logistics system designed for flexible and optimal control of spare parts inventories. IBM has migrated to a Parts Procurement Time (PPT) performance measure, which monitors whether the frequency at which parts are delivered to a customer location within a contractually determined time interval aggregated across machine service groups and geographies meet acceptable thresholds. I will describe the optimization model and algorithms that are currently being successfully deployed which have led to increased service, and reduced transportation costs, and dramatically reduced inventory costs.

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

IMA/MCIM INDUSTRIAL PROBLEM SEMINAR, 570 Vincent Hall:

10:10 am **TBA**

The IMA/MCIM Industrial Problem Seminar is organized by Fadil Santosa

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1:45-3:30	**David Simchi-Levi** MIT	Supply Chain Design Applications
2:30-2:45	**Coffee Break**	EE/CS 3-176

Monday, September 16

The 10:30 IMA break will be in Lind Hall 400.

OPTIMIZATION SEMINAR, Lind Hall 409:

11:15am **TBA**

Tuesday, September 17

The 10:30 IMA break will be in Lind Hall 400.

IMA POSTDOC INTRODUCTION EVENT, EE/CS 3-180:

10:00–3:45	**14 IMA postdocs**	Contact: Don Aaronson

The IMA postdocs give 10 minute presentations of their work.

APPL. MATH. AND NUM. ANAL. SEMINAR, Vincent Hall 570:

3:00pm	**Guido Kanschat** U. Heidelberg	Multilevel-Preconditioning for Discontinuous Galerkin Methods

Variants of a multi-level preconditioner for the interior penalty method are presented. They are analyzed in the framework established by Bramble/Pasciak for symmetric problems and shown to be optimal. Then, the methods are extended to other discontinuous discretizations of elliptic problems. Finally, they are applied to problems of computational fluid dynamics.

Wednesday, September 18

The 10:30 IMA break will be in Lind Hall 400.

Thursday, September 19

The 10:30 IMA break will be in Lind Hall 400.

Friday, September 20

The 10:30 IMA break will be in Lind Hall 400.

Monday, September 23

IMA Workshop:

The Role of Optimization in Supply Chain Management

September 23-27, 2002

Organizers: Brenda Dietrich (Mathematical Sciences, IBM T.J. Watson Research Center), George Nemhauser (Georgia Institute of Technology), and David Simchi-Levi (Engineering Systems, Massachusetts Institute of Technology)

See http://www.ima.umn.edu/optimization/fall/op1.html.

Supply chain management refers to the design, planning, procurement, production, and delivery of materials and other resources used in delivering both products and services to customers. Applications of supply chain management techniques can reduce costs and increase service levels. Supply chain management uses advanced information management and optimization models to design, plan and control the allocation of resources in the production and delivery of products and services.

This workshop will focus on the definition and formulation of large scale structured optimization problems that arise in supply chain management. It will emphasize new problems that are emerging in the movement away from traditional distribution and retail toward electronic commerce. The workshop will include academic researchers, leading industrial practitioners and representatives from advanced supply chain software companies.

In particular, the workshop will focus on:

- New algorithms and software capabilities

- New mathematical models that support new business models
- Methods for transforming vast amounts of data into knowledge to drive business decisions
- Real time algorithms to continually optimize in response to business and marketplace dynamics

The workshop will include presentations and discussions on topics such as:

- Dynamic pricing
- Supply chain design
- Supply chain coordination
- Advanced and complex marketplaces
- Combinatorial auctions
- Transportation optimization
- Service parts optimization
- Available-to-promise models
- Methods for dealing with uncertainty

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

8:30 am	**Coffee and Registration**	Reception Room EE/CS 3-176
9:15 am	**Douglas N. Arnold, Scot Adams** and **Brenda Dietrich**	Welcome and Introduction
9:30–10:20 am	**Jeremy F. Shapiro** Slim Technologies	Business Process Expansion to Exploit Optimization Models for Supply Chain Planning

Abstract: In a recent survey of leading manufacturers about supply chain planning systems, AMR Research found that success with these systems is more dependent on effective change management than technology. In this talk, we discuss aspects of change management, or business process expansion, that need to be better understood if supply chain managers are to more fully exploit optimization models in achieving competitive advantage. The topics to be discussed include:

- Differentiating transactional IT from analytical IT
- Designing and developing software to construct the supply chain decision database from an ERP database
- Understanding and modifying behavioral realities underlying organizational decision-making
- Reconciling exploration and exploitation in the development and use of optimization modeling systems
- Implementing business process expansion to achieve tactical supply chain planning supported by optimization models

10:20 am	**Discussion**	
10:30 am	**Coffee Break**	Reception Room EE/CS 3-176

11:00– 11:50 am	**Ravindra K. Ahuja** University of Florida	Network Optimization in Transportation Scheduling

Abstract: In the past decades, many advances have taken place in road, air, and rail transportation scheduling and substantial savings have been obtained by using better modeling and optimization techniques. Many of the scheduling problems arising in transportation are currently solved using a series of models where the output of one model becomes the input of the next model. The current area of research in this field is to integrate multiple models allowing greater possibilities for improvement. However, integrated models are too large to be solved optimally using existing techniques. We have been involved in developing heuristic techniques to solve several such problems in transportation scheduling which combine neighborhood search techniques with linear and integer programming. The talk will describe some important problems in airline and railroad scheduling, and will outline algorithmic approaches we have developed to solve them. Computational results of these algorithms will also be presented.

11:50 am	**Discussion**
12:00 pm	**Lunch Break**

1:30–2:20 pm	**Marshall Fisher** University of Pennsylvania	Rocket Science Retailing: What research opportunities does it create for us?

Abstract: Retailing is a big industry. In the U.S., retail business represents forty percent of the economy and is the largest employer. Retail supply chain management is still more art than science, but this is changing rapidly as retailers begin to apply analytic models to the huge volume of data they are collecting on consumer purchases and preferences. This industry-wide movement resembles the transformation of Wall Street that occurred in the 1970's when physicists and other 'rocket scientists' applied their analytic skills to investment decisions.

The rocket science retailing movement will create enormous opportunities for our profession. To better understand these opportunities, Ananth Raman and I have been working with about 40 leading retailers to assess their progress towards rocket science retailing and to accelerate that progress through selected research projects with the retailers. This talk will describe findings from this work including:

1) How do retail supply chains function?
2) What decisions arise in retail supply chain management that lend themselves to analysis?
3) Synopsis of prior research on selected topics including managing short life cycle products to maximize life cycle profits, merchandise testing and store level assortment planning?
4) What are the exciting future research frontiers?

2:20 pm	**Discussion**	
2:30 pm	**Coffee Break**	Reception Room EE/CS 3-176
2:45–3:00 pm	**Second chances**	
3:00 pm	**IMA Tea/Poster Session**	IMA East, 400 Lind Hall
Poster Session	**Tianbing Qian** Motorola	Enterprise Capacity Planning at Motorola Semiconductors

Abstract: Sales & Operations Planning (S&OP) is the business process in semiconductor industry where major capital

decisions are made regarding capacity deployment and demand fulfillment for the near to mid-term horizon. With recent trends of semiconductor manufacturing shifting towards offshore foundries and subcontractors, the enterprise level S&OP problem becomes even more global and dynamic. This talk will present modeling issues unique to the semiconductor S&OP problem, describe a large-scale S&OP implementation at Motorola, and discuss challenges facing today's enterprise supply chain planning systems.

Poster Session	**H. Edwin Romeijn** University of Florida	Assignment problems in supply chain optimization

Abstract:We consider logistics problems in a network consisting of retailers and suppliers, where we are interested in finding a minimum cost production, inventory, and transportation plan. We impose a so-called single-sourcing structure on the solution, which means that each retailer is assigned to a single supplier. We can often formulate the constrained problem as a problem with assignment decision variables only, and a nonlinear objective function. We study greedy heuristics as well as a column generation approach to solving the problem to optimality. We pay particular attention to the pricing problems associated with the latter approach. These problems are also of independent interest in settings where suppliers have demand choice flexibility, and the goal is to maximize profit rather than minimize cost.

Tuesday, September 24

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

9:00 am	**Coffee**	Reception Room EE/CS 3-176
9:30–10:20 am	**Paul H. Zipkin** Duke University	A Series System with Returns: Stationary Analysis

Abstract: This paper analyzes a series inventory system with stationary costs and stochastic demand over an infinite horizon. A distinctive feature is that demand can be negative, representing returns from customers, as well as zero or positive. We observe that, as in a system with nonnegative demand, a stationary echelon base-stock policy is optimal here. However, the steady-state behavior of the system under such a policy is different from that in systems with nonnegative demands. We present an exact procedure and several approximations for computing the operating characteristics and system costs for any stationary echelon base-stock policy, and also describe an algorithm for computing a good policy. Finally, we describe how to extend the analysis to the case where returns occur at multiple stages instead of just at the stage closest to demand. (This is joint work with G. DeCroix and J. Song.)

10:20 am	**Discussion**	
10:30 am	**Coffee Break**	Reception Room EE/CS 3-176
11:00– 11:50 am	**David Simchi-Levi** Massachusetts Institute of Technology	Coordinating Inventory Control and Pricing Strategies with Random Demand and Fixed Ordering Cost

Abstract: We analyze a single product, periodic review model in which pricing and production/inventory decisions are made simultaneously. Demands in different periods are random variables that are independent of each other and their distributions depend on the product price. Pricing and ordering decisions are made at the beginning of each period and all shortages are backlogged. Ordering cost includes both a fixed cost and a variable cost proportional to the amount ordered. We consider both the finite and infinite horizon models. In the finite horizon model the objective is to find an inventory policy and a pricing strategy maximizing expected discounted profit over the finite horizon. In the infinite horizon the objective is to maximize expected discounted, or expected average profit. For the finite horizon case, we show, by employing the classical k-convexity concept, that an (s, S, p) policy is optimal when the demand functions are additive. In such a policy, the period inventory is managed based on the celebrated (s, S) policy and price is determined based on

the inventory position at the beginning of each period. For the model with more general demand functions, we show that an (s, S, p) policy is not necessarily optimal. We introduce a new concept, the symmetric k-convex functions, and apply it to provide a characterization of the optimal policy. Surprisingly, in the infinite horizon case, the concept of symmetric k-convex functions allows us to show that a stationary (s, S, p) policy is optimal for both discounted and average profit models even for general demand functions.

11:50 am	**Discussion**	
12:00 pm	**Lunch Break**	
1:30–2:20 pm	**Brenda Dietrich** IBM Research Center	Use of Optimization with IBM's Supply Chain

Abstract: IBM uses optimization throughout its complex supply chain, in activities ranging from product design to production planning to reverse logistics. I will provide an overview of these activities, with details on a few of the more interesting ones.

2:20 pm	**Discussion**	
2:30 pm	**Coffee Break**	Reception Room EE/CS 3-176
3:00–3:50 pm	**Jayashankar M. Swaminathan** University of North Carolina, Chapel Hill	Coordinating Prices on Traditional and Internet Channels

Abstract: The Internet has provided a new avenue to conduct business for both manufacturers and retailers. Two important decisions that need to be considered are - (1) the degree of independence of the new channel and (2) the pricing of goods across the two channels. In this talk, I will first introduce analysis of a monopolistic retailer and study alternative pricing strategies under different degrees of autonomy for the Internet operations using a micro level consumer utility model for demand generation. Next, I will discuss results considering the same issue from a manufacturer's standpoint who has an existing retail channel. Finally, I will discuss theoretical bounds on the performance using a macro level demand model and provide insights on the pricing by pure and hybrid retailers (having both traditional and internet channel) under competition.

3:50 pm	**Discussion**	

Wednesday, September 25

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

9:00 am	**Coffee**	Reception Room EE/CS 3-176
9:30–10:20 am	**Sridhar Tayur** Carnegie Mellon University (CMU)	From 'Academic Building Blocks' to Enterprise Optimization in Supply Chain Management

Abstract: Imbedding Optimization within the workflow at an enterprise-level is the current challenge in supply chain management. This is particularly difficult not only because of the data and user challenges, but also because the available

intellectual property in OR/MS literature is in 'simple building blocks' to begin with. This talk will discuss one approach to bridging this very wide gap.

10:20 am **Discussion**

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

11:00-11:50 am **Robin Roundy**
Cornell University
Strategic Capacity Planning for the Semiconductor Industry: Current Industrial Practice and New Directions

Abstract: Semiconductor manufacturing is one of the world's leading industries. Capacity planning decisions are crucial and challenging. A modern fab costs $1.5-2 billion. About 65% of that is for machine tools. The semiconductor industry is increasingly effected by short and shrinking product life cycles, by fierce competition, by unpredictable and volatile markets, and by rapid changes in technology. Yet this industry relies on machine tools that have very long procurement lead times and are extremely expensive.

We will present an overview of a long-range research effort designed to provide the semiconductor industry with useful tools for optimizing capacity plans in a stochastic environment. We will review current business practices in strategic capacity planning in the semiconductor industry, and will discuss model-based evaluations of some of those practices. We will present new methods for statistically modeling and quantifying the errors in demand forecasts. We will present a novel approach for modeling demand for multi-dimensional capacity planning problems, and discuss the practical and algorithmic implications of different ways of modeling stockouts. We present efficient algorithms for provably solvable versions of the strategic capacity planning problems, and summarize the current status of research on versions that are not provably solvable.

Joint work with Metin Cakanyldirim and Woonghee Tim Huh (School of Operations Research and Industrial Engineering, Cornell University).

11:50 am **Discussion**

12:00 pm **Lunch Break**

1:30–2:20 pm **Laurence Wolsey**
CORE, Louvain-la-Neuve, Belgium
Solving Multi-Item Lot-Sizing Problems with an MIP Solver using Classification and Reformulation

Abstract: Based on research on the polyhedral structure of lot-sizing models over the last twenty years, there is a nontrivial fraction of practical lot-sizing problems that can now be solved by nonspecialists just by taking an appropriate a priori reformulation of the problem, and then feeding the resulting formulation into a commercial mixed integer programming solver.

This approach is based on the fact that many multi-item problems decompose naturally into a set of single-item problems with linking constraints, and that there is now a large body of knowledge about single-item problems. To put this knowledge to use, we propose a classification of lot-sizing problems (in large part single-item), and then indicate in a set of Tables what is known about a particular problem class, and how useful it might be. Specifically we indicate for each class i) whether a tight extended formulation is known, and its size, ii) whether one or more families of valid inequalities are known defining the convex hull of solutions, and the complexity of the corresponding separation algorithms, and iii) the complexity of the corresponding optimization algorithms (which would be useful if a column generation or Lagrangian relaxation approach was envisaged).

Three distinct multi-item lot-sizing instances are then presented to demonstrate the approach, and comparative computational results are presented.

2:20 pm **Discussion**

2:30 pm **Coffee Break** Reception Room EE/CS 3-176

3:00–3:50 pm **S. David Wu**
Lehigh University
Managing High-Tech Capacity via Reservation Contracts
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Abstract: We study capacity reservation contracts in a high-tech manufacturing environment. Motivated by our work at a major telecommunications device manufacturer in the U.S., we consider contracts that allow the manufacturer (the supplier) to share the risk of capacity expansion with her OEM customers (the buyer). This is important, as the capacity cost is enormous in this industry, while the market demand highly volatile. We focus on short-life-cycle, make-to-order products under stochastic demand. The supplier and the buyer are partners who enter a "design-win" agreement to develop the product, and who share demand information. The supplier would expand her capacity in any case, but reservation may encourage her to expand more aggressively. To reserve capacity, the buyer pays a fee upfront while (a pre-specified portion of) the fee is deductible from the order payment. As capacity expansion demonstrates diseconomy of scale in this context, we assume convex capacity costs. We first analyze the players' incentives in a one-supplier, one-buyer setting. We show that as the buyer's revenue margin decreases, the supplier faces a sequence of three profit scenarios with decreasing desirability. We examine the effects of market size and demand variability to the contract conditions, and show that it is the demand variability that affects the reservation fee, and that the convex cost assumption leads to different insights than the linear cost cases in the literature. We generalize the analysis to a one-supplier, two-buyer system where the buyers compete for capacity in a Nash game. We show that the game is sensitive to the reservation fee, and the supplier could dictate whether the buyers play a fixed capacity game (FCG), or a variable capacity game (VCG). We discuss buyer behaviors and their optimal strategy under both situations. We propose a number of channel coordination contracts, and discuss additional cases when the supplier has the option not to comply with the contract, and when the buyer's (in this case, a contract manufacturer) market size is only partially known. I will conclude the talk by summarizing insights useful for high-tech capacity management, and relevance to recent trends in contract manufacturing.

*Joint work with Murat Erkoc.

Dr. S. David Wu is Lee A. Iacocca Professor and Chairman of the Department of Industrial and Systems Engineering at Lehigh University. He is also founder and co-Director of the Manufacturing Logistics Institute (MLI), a research institute created in 1995 to promote the integration between academic and industrial research in Logistics. In 1999, Professor Wu created the Global Manufacturing Logistics Fellows program in partnership with the Wharton School at the University of Pennsylvania. With significant funding from the National Science Foundation, the fellows program forms global alliance with some 14 international institutions throughout Europe, Asia/Pacific and the Mid-East. Professor Wu.s research is in the areas of supply chain coordination; focus on combining the insights from game theoretic and optimization models. He has published more than 80 articles in this and related areas. He is currently co-editing the Handbook of Supply Chain Analysis in the eBusiness Era (Kluwer Academic Press) with David Simchi-Levi (MIT) and Max Shen (Florida). Professor Wu.s research has been supported by NSF, DOD, Sandia National Laboratory and industrial firms such as Agere Systems, Lucent Technologies, Ford, Unisys, and Bethlehem Steel. He currently serves on the editorial boards of IEEE Transactions on Robotics and Automation, IIE Transactions, and Journal of Manufacturing Systems. He holds an M.S. and Ph.D. degrees in Industrial Engineering from the Pennsylvania State University (1987). In 1995-1996, he was a visiting professor at the University of Pennsylvania.

3:50 pm **Discussion**

4:00-5:00 **Discussion**
Software Architecture Issues

Thursday, September 26

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

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

9:30–10:20 am	**Awi Federgruen** Columbia University	A General Equilibrium Model for Retail Industries with Price and Service Competition

Abstract: This paper develops a stochastic general equilibrium inventory model for an oligopoly, in which all inventory constraint parameters are endogenously determined. We propose several systems of demand processes whose distributions are functions of all retailers' prices and all retailers' service levels. We proceed with the investigation of the equilibrium behavior of infinite horizon models for industries facing this type of generalized competition, under demand uncertainty.

We systematically consider the following three competition scenarios. (I) price competition only: here, we assume that the firms' service levels are exogenously specified but characterize how the price and inventory strategy equilibrium varies with the chosen service levels. (II) simultaneous price and service level competition: here, each of the firms simultaneously chooses a service level and a combined price and inventory strategy. (III) two-stage competition: the firms make their competitive choices sequentially; in a first stage, all firms simultaneously choose a service level; in a second stage, the firms simultaneously choose a combined pricing and inventory strategy with full knowledge of the service levlels selected by all competitors.

Joint work with Fernando Bernstein (Fuqua School of Business, Duke University, Durham, NC 27708).

10:20 am	**Discussion**	
10:30 am	**Coffee Break**	Reception Room EE/CS 3-176
11:00– 11:50 am	**Andy Boyd** PROS Revenue Management, Inc.	Revenue Management and Dynamic Pricing in the Supply Chain

Abstract: Supply chain management has historically focused on the planning, scheduling, and operational challenges encountered when supplying physical goods to the market. Equally important yet frequently neglected is the demand side of the equation, an area where the service industries have focused intensively. In particular, the travel and transportation industries have pioneered many highly successful demand management practices. Most notable among these practices is revenue management, which applies forecasting and optimization methodologies to address pricing and/or finished product inventory management. We discuss the role of revenue management and dynamic pricing in the overall value chain, discuss the underlying mathematical concepts that drive the value proposition, and highlight challenges.

11:50 am	**Discussion**
12:00 pm	**Lunch Break**

1:30–2:20 pm	**Warren B. Powell** Princeton University	Adaptive learning algorithms for stochastic resource allocation

Abstract: One of the challenges arising in supply chain management is the need to make decisions before all the information is in. This arises in freight transportation when companies have to move equipment to handle the needs of shippers before their demands become known. The same problem is faced by manufacturers who have to plan what products to make before the size of a market is known, or by the same companies who have to decide how much product to ship to a location. In some cases, a company might want to provide a discount if a customer books an order in advance, in which case the company needs to determine the appropriate size of the discount. In addition to the uncertainty, most real problems are characterized by different types of resources or products and substitutable demands.

We propose an algorithmic strategy based on approximate dynamic programming which replaces the value function with a special class of functional approximations. The method requires using an unusual dynamic programming recursion, and easily handles very large scale problems. The strategy is provably optimal for some special cases, and appears to outperform provably optimal algorithms for more general cases because it has a much faster rate of convergence. It also

has the nice property of naturally producing integer solutions.

The talk will describe problems where the technique is being put into production, and outline some remaining research challenges.

2:20 pm	**Discussion**	
2:30 pm	**Coffee Break**	Reception Room EE/CS 3-176
3:00–3:50 pm	**Alan King** IBM Thomas J. Watson Research Center	Optimization Models for the Financial Valuation of Supply Chain Risks

Abstract: The valuation of financial options, as is well known, is based on the recognition that an option's payouts can be replicated by a trading program that "manufactures" an equivalent payout distribution from an initial infusion of cash equal to the value of the option. One may in fact develop a quite satisfactory and practical theory of options pricing based on an optimization formulation of this replication model as a multiperiod stochastic production-inventory problem. This talk will explore how this optimization-based valuation approach may be extended to the valuation and management of risky supply chain contracts.

3:50 pm	**Discussion**	
6:00 pm	**Workshop Dinner**	Gardens of Salonica, 19 NE 5th Street, Minneapolis, 612-378-0611

APPL. MATH. AND NUM. ANAL. SEMINAR, Vincent Hall 570:

11:30am	**Dominik Schoetzau** U. Basel	Mixed discontinuous Galerkin methods for saddle point problems

We consider mixed discontinuous Galerkin methods for the discretization of saddle point problems. The main motivations for using discontinuous methods in these problems are their robustness in convection-dominated regimes, their flexibility in the mesh-design and their freedom in choosing element pairings without excessive stabilization.

We first discuss mixed discontinuous Galerkin methods for the Stokes operator in incompressible fluid flow. The derivation of these methods is explained for velocity-pressure elements of the type $\mathcal{Q}_k - \mathcal{Q}_k$ and $\mathcal{Q}_k - \mathcal{Q}_{k-1}$. It is shown that these elements satisfy suitable inf-sup conditions on geometric meshes in polygonal and polyhedral domains. A series of numerical results demonstrates that the methods perform well for a wide range of the Reynolds numbers.

We then apply similar techniques in the context of the time-harmonic Maxwell's equations and present a new discontinuous Galerkin discretization of the Maxwell operator in mixed form chosen to provide control chosen to provide control on the divergence of the electric field. Our theoretical results are tested in a series of numerical examples.

Friday, September 27

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

9:00 am	**Coffee**	Reception Room EE/CS 3-176
9:30–10:20 am	**Robert C. Leachman** University of California at Berkeley	Scheduling Dedicated Lithography Equipment

Abstract: A common strategy to achieve a successful and stable process for the fabrication of advanced digital semiconductors involves what is termed the dedication of lithography equipment. In order to maximize registration of multiple mask layers, the same machine may be required to be used for the exposure of critical layers. Moreover, only certain machines matched to a given machine may be used at other layers.

This strategy poses a considerable challenge for scheduling lot releases. Lots must be assigned to machines before release, and, once released, cannot be re-assigned. It is difficult to balance utilization of lithography equipment, resulting in situations where some machines have large queues yet others are idle.

A scheduling system based on integer goal programming has been developed and implemented to cope with this challenge. Multiple objective functions for minimizing machine overloads and balancing equipment workloads are optimized. Implementation in one advanced fabrication facility reduced average queue times at lithography by about 40%, resulting in product flow time reduction of about 36 hours.

10:20 am	**Discussion**	
10:30 am	**Coffee Break**	Reception Room EE/CS 3-176

IMA/MCIM INDUSTRIAL PROBLEM SEMINAR, 570 Vincent Hall:

10:10 am	**Anton Leykin** School of Mathematics, U of M	2-dim guillotine cutting problem: 3 different approaches

The IMA/MCIM Industrial Problem Seminar is organized by Fadil Santosa

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11:00–11:50 am	**Moshe Kress** Center for Military Analyses, Haifa, Israel	Optimizing Supply Chains in Military Operations

Abstract: During military operations, supplies such as fuel, ammunition and food are delivered to the theater of operations by a large-scale supply chain. This chain originates at the strategic level (e.g., depots, arsenals and home bases) and terminates at the tactical level (e.g., battalions). There are some fundamental differences between a business supply chain and its military counterpart. The main differences are in the underlying logistic network, the characterization of uncertainty and the measures of effectiveness and efficiency that are utilized. In this talk we present the main features of a military supply chain during a military operation and discuss some typical stochastic optimization modeling issues.

11:50 am	**Discussion**	
12:00 pm	**Lunch Break**	
1:30–2:20 pm	**Dan Adelman** The University of Chicago	The Price-Directed Approach to Approximate Dynamic Programming: Application to Inventory Routing

Abstract: In recent years there has been growing interest in approximate dynamic programming techniques for solving operational problems in the supply chain that are not amenable to traditional lines of analysis. Attention thus far has focused on devising rigorous simulation-based methods for adaptively computing value function approximations.

We will present a different, complementary approach to approximate dynamic programming, which we call price-directed control, that computes value function approximations directly using optimal dual prices of math programming models. These models are tractable relaxations of the underlying control problem. The resulting approximations are not subject to randomness and simulation error, and thus have more stable convergence properties. They also yield a bound against which the performance of any policy, including the price-directed policy, can be compared to obtain a guarantee relative to an optimal policy. Furthermore, duality theory can be exploited to discover economic and structural properties potentially useful to managers. However, the resulting models still can be challenging to solve, so there is opportunity for researchers to devise new computational techniques and paradigms in conjunction with new applications of the technique.

This talk will be a detailed case study on how to apply this approach in the context of inventory routing, which remains one of the most important unsolved problems in the supply chain.

2:20 pm **Discussion**

Saturday, September 28

IMA "Hot Topics" Workshop:

Operational Modeling and Biodefense: Problems, Techniques, and Opportunities

September 28, 2002

Organizers: Douglas N. Arnold (Director, IMA), Mac Hyman (Los Alamos National Laboratory), Edward H. Kaplan (Management Sciences, Yale University)

Cosponsored with the Society for Industrial and Applied Mathematics (SIAM) and with additional support from the University of Minnesota Consortium on Law and Values in Health, Environment & the Life Sciences.

See http://www.ima.umn.edu/optimization/fall/biodefense.html

Description:

Even before the September 11 terrorist attacks, the multiple threats posed by bioterrorism had been scrutinized for some time. The greatest attention has been devoted to identifying and classifying various offensive biological agents. The Centers for Disease Control describes three agent/disease categories in descending order of threat

(see http://www.bt.cdc.gov/Agent/Agentlist.asp).

The most serious concerns are those contained in Category A: anthrax, botulism, plague, smallpox, tularemia, and viral hemorrhagic fevers such as Ebola.

While epidemiologists and other medical scientists have invested considerable time and energy in describing the mode of transmission/spread and disease spectrum of potential offensive biological agents, much less attention has been devoted to the analysis of actual biodefense proposals. The deliberate mailing of anthrax and consequent illness and fatalities provided a bioterror "proof of concept," and also illustrated the inadequacy of decision-making systems in place at the time to respond to such an attack. It seems clear that the actual logistics and operations of biodefense prevention and response policies, in addition to the specifics of whatever bioterror agents are involved, will determine the consequences of future bioterror attacks. In short, what we do to bioterror matters as much as what bioterror does to us.

This conference is the first to highlight the role of mathematical modeling in analyzing the operational and logistical aspects of biodefense planning and response. Presentations will range from discussions of the general threats posed by terrorism to global supply chains to the specifics of proposed emergency responses to a smallpox attack. Issues expected to surface include (but are not limited to) the personnel requirements and assignments required to respond to bioterror events; required inventories of various vaccines and their optimal deployment; and optimal quarantine and vaccination policy.

Throughout we will emphasize the importance of actual operations, whether in normally functioning systems (e.g. the US postal service) or in emergency response (e.g. contact tracing and vaccination).

This meeting will bring together a diverse group of scientists, engineers, and others from fields such as operations research, decision science, mathematics, economics, epidemiology, infectious disease, and public health to explore the use of mathematical techniques in countering the threat of terrorism.

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

8:30–8:50 am	**Coffee and Registration**	Reception Room EE/CS 3-176
8:50–9:00 am	**Douglas N. Arnold and Scot Adams**	Welcome and Introduction
9:00–9:45 am	**Moshe Kress** Center for Military Analyses, Israel	Operational and Logistical Aspects of Biodefense
9:45–10:05 am	**Discussion**	
10:05– 10:50 am	**Martin I. Meltzer** Center for Disease Control	Operational Modeling Opportunities in Biodefense
10:50– 11:10 am	**Discussion**	
11:10– 11:30 am	**Coffee Break**	Reception Room EE/CS 3-176
11:30 am– 12:15 pm	**Martin I. Meltzer** Center for Disease Control	Operational Modeling Opportunities in Biodefense
12:15– 12:35 pm	**Discussion**	
12:35– 2:00 pm	**Lunch Break**	
2:00–2:45 pm	**Glenn Webb** Vanderbilt University	Modeling the Spread of Anthrax through the Mail
3:05–5:30 pm	**This time will be configured flexibly in response to the suggestions of participants and the preceding discussion. It will include short presentations, open discussion, and a closing panel/summary discussion on Problems, Techniques, and Opportunities in Biodefense.**	
6:45 pm	**Workshop Dinner**	Oddfellows Restaurant, 401 East Hennepin Avenue, (612) 378-3179

Monday, September 30

The 10:30 IMA break will be in Lind Hall 400.

OPTIMIZATION SEMINAR, Lind Hall 409:

11:15am **TBA**

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PART III: CURRENT IMA PARTICIPANTS

POSTDOCTORAL MEMBERS FOR 2002–2003 PROGRAM YEAR

NAME	PREVIOUS INSTITUTION
Yusuf Bilgin Altundas	Pittsburgh University
Olga Brezhneva	Russian Academy of Sci.
Dacian Daescu	University of Iowa
Gregory S. Duane	University of Colorado
Michael Efroimsky	Harvard and Oxford
Lisa Evans	Georgia Tech
Balaji Gopalakrishnan	Georgia Tech
Lili Ju	Iowa State University
Herve Kerivin	University Blaise Pascal-France
Daniel Kern	University of Illinois-Chicago
Aurilia Minut	Michigan State University
Haewon Nam	Texas A& M University
M. Yvonne Ou	University of Delaware
Tamon Stephen	University of Michigan
Jing Wang	University of Minnesota
Toshio Yoshikawa	University of Utah
Jun Zhao	Texas A& M University

POSTDOCTORAL MEMBERS IN INDUSTRIAL MATHEMATICS

NAME	PREVIOUS INSTITUTION	INDUSTRIAL AFFILIATION
Yusuf Altundas	University of Pittsburgh	Schlumberger
Lili Ju	Iowa State University	VA Hospital
Aurelia Minut	Michigan State University	3M
Haewon Nam	Texas A & M University	Schlumberger
Jun Zhao	Texas A & M University	GE

VISITORS IN RESIDENCE (as of 20 August 2002)

ADAMS, SCOT	Univ of Minnesota	SEP 7 - 8
ADELMAN, DAN	Univ of Chicago	SEP 22 - 27
AHUJA, RAVI	Univ of Florida	SEP 22 - 27
ALLEN, BETH	Univ of Minnesota	AUG 15 - DEC 31
ALTUNDAS, YUSUF BILGIN	Univ of Pittsburgh	SEP 3 - 2
ARNOLD, DOUG N.	IMA	SEP 1 - JUN 30
BAHN, DAVID	Metropolitan State Univ	SEP 10 - 13

BAHN, DAVID	Metropolitan State Univ	SEP 23 - 27
BALL, MICHAEL	Univ of Maryland	SEP 2 - 13
BARNHART, CINDY	MIT	SEP 7 - 13
BASSOK, YEHUDA	Univ of Southern California	SEP 22 - 28
BIENSTOCK, DANIEL	Columbia Univ	SEP 8 - 10
BIRGE, JOHN R.	Northwestern Univ	SEP 8 - 13
BIXBY, ROBERT E.	ILOG, Inc.	SEP 22 - OCT 19
BLOWER, SALLY	UCLA School of Medicine	SEP 27 - 28
BORUCKI, LEONARD	Motorola, Inc.	SEP 7 - 8
BOYD, ANDY	PROS Revenue Management, Inc.	SEP 25 - 27
BOYD, ANDY	PROS Revenue Management, Inc.	SEP 8 - 13
BREZHNEVA, OLGA	Russian Academy of Sciences	SEP 3, 2002 - SEP 2, 2003
BUCHMEIER, ANTON GEORG	Siemens	SEP 7 - 10
CALDERER, M. CARME	Univ of Minnesota	SEP 1 - JUN 30
CAULKINS, JONATHAN P.	Carnegie Mellon Univ	SEP 27 - 29
CLAYPOOL, ROBERT G.	Department of Veterans Affairs	SEP 27 - 28
COULLARD, COLLETTE	Northwestern Univ	SEP 1 - JUN 30
DAESCU, DACIAN	IMA	SEP 1 - JUN 30
DANILA, RICHARD	Minnesota Department of Health	SEP 27 - 28
DAVIS, TED	Univ of Minnesota, Twin Cities	SEP 7 - 8
DIETRICH, BRENDA	IBM Corporation	SEP 7 - 9, SEP 22 - 28
DONOHUE, KAREN	Univ of Minnesota	SEP 23 - 27
DUANE, GREGORY S.	IMA	SEP 1 - JUN 30
EFROIMSKY, MICHAEL	IMA	SEP 1 - JUN 30
EUBANK, STEPHEN	Los Alamos National Laboratory	SEP 27 - 28
EVANS, LISA	Georgia Institute of Technology	AUG 8 - 31
FEDERGRUEN, AWI	Columbia Univ	SEP 22 - 27
FISHER, MARSHALL L.	Univ of Pennsylvania	SEP 22 - 27
FOURER, ROBERT	Northwestern Univ	SEP 8 - 13
GLOCKNER, GREGORY	ILOG, Inc.	SEP 8 - 13
GOPAL, VIPIN	Honeywell	SEP 23 - 27
GOPALAKRISHNAN, BALAJI	Georgia Institute of Technology	SEP 3, 2002 - SEP 2, 2003
GUPTA, DIWAKAR	Univ of Minnesota	SEP 23 - 27
HILL, ARTHUR V.	Univ of Minnesota	SEP 11 - 13
JAIN, NARESH	Univ of Minnesota	SEP 7 - 8
JORDAN, RICHARD	Dynamic Technologies	SEP 27 - 28
JU, LILI	Iowa State Univ	SEP 3, 2002 - SEP 2, 2003
JUENGER, MICHAEL	Universitaet zu Koeln	SEP 8 - 13
KAMINSKY, PHILIP	Univ of California-Berkeley	SEP 22 - 27
KAPER, HANS	National Science Foundation	SEP 27 - 28
KAPLAN, EDWARD	Yale Univ	SEP 27 - 28
KATOK, ELENA	Penn State Univ	SEP 22 - 27
KEPLER, THOMAS	Duke Univ Medical Center	SEP 27 - 28
KERIVIN, HERVE	France Telecom R&D	AUG 26 - SEP 2
KERN, DANIEL	IMA	SEP 1 - JUN 30
KESKINOCAK, PINAR	Georgia Institute of Technology	SEP 22 - 27
KETTENRING, JON	Telcordia Technologies (Bellcore)	SEP 7 - 9
KING, ALAN	IBM T.J. Watson Research Center	SEP 22 - 28
KLAMPFL, ERICA ZIMMER	Ford Motor Company	SEP 7 - 10
KLAMPFL, ERICA ZIMMER	Ford Motor Company	SEP 21 - 27
KOOPMAN, JAMES	Univ of Michigan	SEP 27 - 28
KRESS, MOSHE	Center of Military Analyses, Israel	SEP 23 - 29
KRYLOV, NICOLAI	Univ of Minnesota	SEP 1 - AUG 31
LEACHMAN, ROBERT C.	Univ of California at Berkeley	SEP 22 - 27
LEE, JON	IBM, T.J. Watson Research Center	SEP 8 - 13
LIN, GRACE	IBM Corporation	SEP 22 - 27

LIU, HU	Univ of Minnesota	SEP 9 - 13
LIU, HU	Univ of Minnesota	SEP 23 - 27
LOWENGRUB, JOHN	Univ of Minnesota	SEP 1 - JUN 30
LUSTIG, IRVIN	ILOG	SEP 22 - 27
MAGAZINE, MICHAEL	Univ of Cincinnati	SEP 22 - 27
MARIN, SAMUEL	General Motors	SEP 7 - 9
MARTIN, ALEXANDER	Darmstadt Univ of Technology	SEP 29 - OCT 19
MCKENZIE, ELLIS	National Institutes of Health	SEP 27 - 28
MELNICHUK, VADIM	Metro State Univ	SEP 9 - 13
MELTZER, MARTIN	Center for Disease Control	SEP 27 - 28
MINUT, AURELIA	IMA	SEP 1 - AUG 31
MISEMER, DAVID	3M	SEP 7 - 9
MOEHRING, ROLF	Technische Universitat Berlin	SEP 22 - 28
NAM, HAEWON	Texas A&M Univ	SEP 3, 2002 - SEP 2, 2003
NAU, RICHARD	Carleton College	SEP 1 - DEC 31
NELSON, BLAINE	Synergy, Inc.	SEP 27 - 28
NEMHAUSER, GEORGE L.	Georgia Institute of Technology	SEP 8 - 13
NG, PEH	Univ of Minnesota-Morris Campus	AUG 1 - JUL 31
OU, M. YVONNE	IMA	SEP 1 - JUN 30
PAVELICH, JANET	Institute for Defense Analyses	SEP 27 - 29
PORCO, TRAVIS C.	San Francisco Dept of Public Health	SEP 27 - 28
POWELL, WARREN	Princeton Univ	SEP 22 - 27
QIAN, TIANBING	Motorola	SEP 22 - 28
QUEYRANNE, MAURICE	Univ of British Columbia	SEP 2 - DEC 20
ROBERTS, FRED	Rutgers Univ	SEP 27 - 28
ROMEIJN, H. EDWIN	Univ of Florida	SEP 22 - 27
ROSENTHAL, RICK	Naval Postgraduate School	SEP 22 - 28
ROUNDY, ROBIN	Cornell Univ	SEP 22 - 25
SANTOSA, FADIL	Univ of Minnesota	SEP 7 - 8
SAVELSBERGH, MARTIN	Georgia Institute of Technology	SEP 8 - 13, SEP 22 - 27
SCHULTZ, RUEDIGER	Gerhard-Mercator Univ Duisburg	SEP 29 - OCT 19
SCHULZ, ANDREAS	MIT	SEP 8 - 13
SCHWARTZ, IRA	Naval Research Lab	SEP 27 - 28
SELIM, SHOKRI Z.	King Fahd Univ of Petroleum & Minerals	SEP 21 - 28
SENDIL, M. NURI	Northwestern Univ	SEP 2 - JUN 30
SEYED, JAVAD	North Carolina State Univ	SEP 22 - 28
SHAPIRO, JEREMY F.	Slim Technologies	SEP 22 - 28
SHARP, DAVID	Los Alamos Natioanal Laboratory	SEP 7 - 9
SHEFFI, YOSSI	MIT	SEP 22 - 27
SIEGMUND, STEFAN	Georgia Institute of Technology	APR 8 - SEP 19
SIMCHI-LEVI, DAVID	MIT	SEP 12 - 13
SIMCHI-LEVI, DAVID	MIT	SEP 22 - 27
SPERA, COSIMO	Saltare, Inc.	SEP 22 - 28
STARK, CHRIS	National Science Foundation	SEP 8 - 13
STEPHEN, TAMON	Univ of Michigan	AUG 12, 2002 - SEP 2, 2003
SULLIVAN, JOHN	Synergy, Inc.	SEP 27 - 28
SVERAK, VLADIMIR	Univ of Minnesota	SEP 1 - AUG 31
SWAMINATHAN, J.	Univ of North Carolina, Chapel Hil	SEP 22 - 27
TAYUR, SRIDHAR R.	Carnegie Mellon Univ	SEP 22 - 27
TEO, CHUNG-PIAW	National Univ of Singapore	SEP 22 - 27
TRICK, MICHAEL	Carnegie Mellon Univ	SEP 22 - 29
VAN OORTMERSSEN, GERARD	CWI	SEP 7 - 9
VENKATARAMANAN, LELITHA	Schlumberger-Doll Research	SEP 7 - 9
VENKATASUBRAMANYAN, N.	i2 Technologies	SEP 22 - 28
WANG, JING	Univ of Minnesota	SEP 3, 2002 - SEP 2, 2003
WEBB, GLENN	Vanderbilt Univ	SEP 27 - 28

WEERASINGHE, ANANDA	Iowa State Univ	SEP 8 - 10
WEIN, LAWRENCE M.	MIT	SEP 27 - 28
WILSON, AMY R.	Univ of Minnesota	SEP 27 - 28
WOLSEY, LAURENCE	Univ of Louvain	SEP 22 - 27
WOMBLE, DAVID	Sandia Laboratories	SEP 7 - 10
WU, DAVID	Lehigh Univ	SEP 22 - 28
YIN, KEWEN KAREN	Univ of Minnesota	SEP 9 - 13
YOSHIKAWA, TOSHIO	IMA	SEP 1 - JUN 30
ZELICOFF, ALAN	Sandia National Laboratories	SEP 27 - 28
ZHAO, JUN	Texas A&M Univ	SEP 3, 2002 - SEP 2, 2003
ZIPKIN, PAUL H.	Duke Univ	SEP 22 - 28

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