

P.C. ROSSIN

COLLEGE OF ENGINEERING
INDUSTRIAL & SYSTEMS ENGINEERING

2005



ANNUAL REPORT



LEHIGH
UNIVERSITY

MISSION



MISSION STATEMENT

To pursue excellence and national prominence in the areas of operations research, information technology, manufacturing, and related fields of Industrial Engineering through innovative teaching, distinguished research and scholarship, and active professional leadership. Building on its unique strength and national reputation in undergraduate education and industrial research, the department strives for leadership in educational innovation, multidisciplinary research, and industrial partnership. Our ultimate mission is to produce leaders who have learned to think critically and analytically, have the skills and techniques to comprehend and create new knowledge, and are willing to serve and inspire others.



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LETTER FROM DEPARTMENT CHAIR



Another year has passed with our students and faculty forging new areas in industrial engineering, information and systems engineering, and operations research. Our faculty received six new grants from federal agencies to study a variety of topics, from developing optimization software, to studying communications networks, to designing responsive supply chains, to developing better ways to make decisions under uncertainty. Given the competition for getting these grants, this is truly a remarkable achievement. In all, 75% of the faculty was participating in federally funded research this past year. We look forward to seeing the breakthroughs develop over time!

We graduated a record number of Ph.D.s this year, with nine entering industry and academia, and a total of 90 students receiving degrees from the department. As with recent trends, our students were placed in all walks of life — from banking and insurance to logistics and manufacturing. The demand for our students continues to be strong with the number of companies interviewing on campus continuing to grow.

I had the pleasure of taking over the reigns of the department in an official capacity this year. I hope to continue the work of growing the department, both in the number of students and reputation, as my predecessor, S. David Wu did during his six-year term. Fortunately, David is still active in the department and still has a cadre of graduate students.

As always, send us your thoughts and comments as we move forward. Feel free to write me, send email (jch6@lehigh.edu), or drop by for a visit.

Joseph C. Hartman
Soteria and George N. Kledaras Endowed Chair
Department Chair



FACULTY MEMBERS



John W. Adams, Ph.D.

Professor Emeritus
jwa0@lehigh.edu

Dr. Adams joined the faculty in 1965 and retired in 1995. During those years, he taught statistics and operations research, and has continued to teach engineering statistics and product quality during his retirement, as well as directing the research of several Ph.D. students and serving as an advisor to a number of Master's degree candidates. Over the years, Dr. Adams has been a consultant at various companies in helping to solve problems in quality control.

Education: Ph.D., Mathematical Statistics
 (University of North Carolina at Chapel Hill)
 B.S., Chemical Engineering (University of Nebraska)



Rosemary T. Berger, Ph.D.

Assistant Professor
rtb3@lehigh.edu

In addition to co-directing the Computational Optimization Research at Lehigh (COR@L) lab, Dr. Berger teaches courses in operations research, networks and graphs, nonlinear programming, and freshmen engineering practicum. Her research interests include design and analysis of communication networks, integrated models for supply chain planning and design, and large-scale optimization. Dr. Berger joined the faculty in Fall 2002.

Education: Ph.D., Industrial Engineering and Management Sciences
 (Northwestern University)
 M.S., Industrial Engineering and Management Sciences
 (Northwestern University)
 B.S., Mathematics (The College of William and Mary)



Keith M. Gardiner, Ph.D., P.E.

Professor
kg03@lehigh.edu

Dr. Gardiner serves as the Director of the Center for Manufacturing Systems Engineering, and the associated cross-disciplinary Master of Science in Manufacturing Systems Engineering program, while also coordinating the first year practical engineering course. He teaches courses in organizational planning and control, manufacturing management and systems, and micro-manufacturing.

Dr. Gardiner's research interests include product, process and systems design, materials and process selection, micro-manufacturing, sustainability, and bioengineering. Dr. Gardiner joined the faculty in 1987.

Education: Ph.D., Metallurgy (University of Manchester, England)
B.Sc., Metallurgy, (University of Manchester, England)



Mikell P. Groover, Ph.D., P.E.

Professor
mpg0@lehigh.edu

Dr. Groover serves as the Director of the George E. Kane Manufacturing Technology Laboratory. He has been the principal investigator and contract administrator for research contracts sponsored by the National Science Foundation (NSF), the U.S. Department of Housing and Urban Development, the Ben Franklin Partnership Program in Pennsylvania, the Advanced Research Projects Agency (ARPA), and several industrial corporations.

Dr. Groover has authored four books dealing with the subjects of automation, production systems, and computer-aided design and manufacturing, and he was co-author for two additional books. Dr. Groover has taught courses and has engaged in research in the areas of manufacturing processes, metal cutting theory, automation, production systems, robotics, material handling, operations management, and agile manufacturing. He joined the faculty in 1966 after several years in industry.

Education: Ph.D., Industrial Engineering (Lehigh University)
M.S., Industrial Engineering (Lehigh University)
B.S., Mechanical Engineering (Lehigh University)
B.A., Arts and Science (Lehigh University)



Joseph C. Hartman, Ph.D., P.E.

Associate Professor and Department Chair
jch6@lehigh.edu

Dr. Hartman holds the Soteria and George N. Kledaras Endowed Chair. His research focuses on problems in engineering economic decision analysis, transportation logistics, and manufacturing logistics, with specific interests in capacity planning and equipment replacement. Dr. Hartman teaches courses in production and inventory control, engineering economy, engineering computations,

networks and graphs, advanced engineering economy and replacement analysis. He also serves as the department's graduate advisor. Dr. Hartman joined the I.S.E. faculty as a visitor in 1996.

Education: Ph.D., Industrial & Systems Engineering (Georgia Institute of Technology)
M.S., Industrial Engineering (Georgia Institute of Technology)
B.S., General Engineering (University of Illinois at Urbana-Champaign)



Jeffrey T. Linderoth, Ph.D.

Assistant Professor
jtl3@lehigh.edu

Dr. Linderoth's research interests are in the computational and theoretical aspects of large-scale numerical optimization. He teaches courses in optimization and deterministic operations research modeling. Dr. Linderoth has worked as a scientist at Argonne National Lab and as a consultant with Axioma, Inc. He is a recipient of the 2002 SIAM Activity Group on Optimization Prize and

received an Early Career Development Award from the Department of Energy in 2005. Dr. Linderoth joined the I.S.E. faculty in 2002.

Education: Ph.D., Industrial Engineering (Georgia Institute of Technology)
M.S., Operations Research (Georgia Institute of Technology)
B.S., General Engineering (University of Illinois at Urbana-Champaign)



Nicholas G. Odrey, Ph.D.

Professor
ngo0@lehigh.edu

Dr. Odrey's research interests are in systems engineering as related to production and manufacturing, flexible automation, robotics, and, in general, the dynamics, modeling, and control of production systems. Past research has included optimal design of materials for metal machining, computer aided process planning, robotic applications, and hierarchical control of production systems. A

major focus pertains to hierarchical architectures and developing multi-level, multi-layer models to optimize and coordinate at and among these levels within the context of production and supply chain systems. He teaches courses in intelligent manufacturing systems, flexible automation and robotics, measurement and inspection systems, and manufacturing/production engineering. He joined the faculty in 1983.

Education: Ph.D., Industrial Engineering (Penn State University)
M.S., Aerospace Engineering (Penn State University)
B.S., Aerospace Engineering (Penn State University)



Eugene Perevalov, Ph.D.

Assistant Professor
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In addition to his doctorate degree, Dr. Perevalov performed post-doctorate work at the Massachusetts Institute of Technology and Harvard. His research activities fall into three areas: modeling and analysis of wireless ad hoc networks (with a particular interest in the problem of information capacity and its dependence on node mobility), product portfolio management, and dynamic optimization

and its applications. Dr. Perevalov teaches courses in operations research, statistics, and game theory. He joined the faculty in 2001.

Education: Ph.D., Applied Mathematics / Mathematical Physics (University of Texas)
M.S., Theoretical Physics (Moscow Engineering Physics Institute)



Louis J. Plebani, Ph.D.

Associate Professor
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Dr. Plebani's research interests are in the areas of modeling of manufacturing processes, computational operations research, and automation and process control. He is currently involved in research work in all three of these major areas. Sample projects include high speed data acquisition and spectrum analysis of metal removal processes for purposes of predicting catastrophic tool

wear; the design and implementation of specialized parallel processing algorithms using workstation networks and also for implementation using heterogeneous embedded processors; and the design and implementation of a high-speed electronic part sorting system. He has been the principal investigator on a number of research contracts for both federal and local governments and for numerous industrial firms. Dr. Plebani joined the faculty in 1976.

Education: Ph.D., Industrial Engineering (Lehigh University)
M.S., Statistics and Operations Research (American University)
B.S., Engineering Physics (Lehigh University)



Ted K. Ralphs, Ph.D.

Assistant Professor
tkr2@lehigh.edu

Dr. Ralphs is a co-founder and co-director of the Computational Optimization Research at Lehigh (COR@L) Laboratory and chairs Lehigh's High-performance Computing Steering Committee. Dr. Ralphs' research focuses on theoretical and computational aspects of the solution and analysis of mixed-integer linear programs, including the implementation of parallel algorithms and the use of

high-performance computing platforms. Courses taught by Dr. Ralphs include an introduction to mathematical programming, integer programming, nonlinear programming, and algorithms in systems engineering. Dr. Ralphs has been with the faculty since 2000.

Education: Ph.D., Operations Research (Cornell University)
M.S., Mathematics (Carnegie Mellon)
B.S., Applied Mathematics / Operations Research (Carnegie Mellon)



Andrew M. Ross, Ph.D.

Assistant Professor
amr5@lehigh.edu

Dr. Ross's research focuses on queueing theory, discrete-event simulation, demand forecasting, databases and data mining, telecommunications, logistics, and electricity market structures. His work includes call centers and Internet access systems, both of which see arrival rates that fluctuate with the time of day. He also has an interest in markets for electric power. He teaches courses in

probability, stochastic models and applications, and queueing theory. Dr. Ross joined the faculty in January of 2002.

Education: Ph.D., Industrial Engineering and Operations Research (UC Berkeley)
M.S., Industrial Engineering and Operations Research (UC Berkeley)
B.S., Mathematics (Harvey Mudd College)



Lawrence V. Snyder, Ph.D.

Assistant Professor
lvs2@lehigh.edu

Dr. Snyder serves as co-director of the Center for Value Chain Research at Lehigh University. He teaches courses in production and inventory control, quantitative models in supply chain management, advanced inventory theory, and operations research. His research interests are in supply chain management, logistics, transportation, and facility location problems, models for decision-

making under uncertainty, applied optimization, integer programming algorithms and heuristics. Dr. Snyder joined the I.S.E. faculty in Fall 2003.

Education: Ph.D., Industrial Engineering (Northwestern University)
M.S., Industrial Engineering (Northwestern University)
B.A., Mathematics (Amherst College)



Robert H. Storer, Ph.D.

Professor
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Dr. Storer is the Co-Director of the Integrated Business and Engineering Honors Program. His research interests include heuristic optimization, logistics, scheduling and routing, combinatorial optimization, and "balancing and partitioning". He teaches courses in heuristic optimization, simulation, and applied statistics. Dr. Storer joined the I.S.E. faculty in 1986.

Education: Ph.D., Industrial and Systems Engineering (Georgia Tech)
M.S., Operations Research (Georgia Tech)
B.S., Industrial and Operations Engineering (University of Michigan)



Aurélie C. Thiele, Ph.D.

Assistant Professor
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Dr. Thiele's primary research interests are in decision-making under uncertainty, in particular when little information is available about the underlying probability distributions and the decision-maker is risk-averse. Her recent work has focused on describing the uncertainty (i) using uncertainty sets, which has led to an approach based on robust optimization, and (ii) using the historical

data, which has led to data-driven models. She teaches courses on deterministic and stochastic optimization. Dr. Thiele joined the I.S.E. faculty in 2004.

Education: Ph.D., Electrical Engineering and Computer Science (MIT)
M.S., Electrical Engineering and Computer Science (MIT)
Diplôme d'ingénieur (Ecole des Mines de Paris, France)



Gregory L. Tonkay, Ph.D.

Associate Professor and Associate Department Chair
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Dr. Tonkay's research interests are in the area of integration and control of manufacturing systems. He has developed control systems for both discrete parts systems and continuous systems. He is the director of the Electronics Manufacturing Laboratory. Further interests include manufacturing processes such as machining, abrasive water jet machining, and welding; data collection; and data processing. He teaches courses in industrial control systems, automation and production systems, and databases and networking. Dr. Tonkay has been with the faculty since 1986.

Education: Ph.D., Industrial Engineering (Penn State University)
B.S., Industrial Engineering (Penn State University)



George R. Wilson, Ph.D.

Associate Professor
grw3@lehigh.edu

Dr. Wilson teaches courses in production control, operations research, nonlinear programming, stochastic processes, scheduling, and dynamic programming. His research interests are applied stochastic processes, optimization, production planning and control, modeling and analysis of logistic systems. Dr. Wilson has been a member of the faculty since 1978.

Education: Ph.D., Industrial Engineering/Operations Research (Penn State University)
M.S., Industrial Engineering (Penn State University)
B.S., Industrial Engineering (Penn State University)



S. David Wu, Ph.D.

Dean of the P.C. Rossin College of Engineering & Applied Science and Iacocca Professor
sdw1@lehigh.edu

S. David Wu is Dean of the P.C. Rossin College of Engineering and Applied Science and the holder of the Lee A. Iacocca endowed chair. Dean Wu was chairman of the Industrial and Systems Engineering (ISE) department for six years prior to his appointment as dean. He is a well-known scholar in optimization, game theory, and supply chain modeling, and he has developed and implemented innovative methods for demand and capacity analysis for the semiconductor industry. His research has received significant support from agencies such as NSF, DOD, SRC, and various industrial firms. In 1999, he helped establish an NSF IGERT doctoral fellows program in Global Manufacturing Logistics in partnership with the Wharton School, University of Pennsylvania. In 2002, he co-founded the Center for Value Chain Research, a joint effort between the engineering and business colleges at Lehigh University. A fellow of the Institute of Industrial Engineers, Dean Wu has published more than 80 archival articles and served as editor or editorial board member on more than a handful of scholarly journals.

Education: Ph.D., Industrial Engineering (Pennsylvania State University)
M.S., Industrial Engineering (Pennsylvania State University)
B.S., Industrial Engineering (Tunghai University, Taiwan)



Emory W. Zimmers, Jr., Ph.D.

Professor
ewz0@lehigh.edu

Dr. Zimmers is the Director of the National Science Foundation's Center for Engineering Logistics and Distribution at Lehigh University (CELDi). His research interests include computer control of industrial systems, agility applications in manufacturing, logistics and distribution systems, new techniques in multi-media distance learning, entrepreneurship, and leadership development. His research is coordinated with the Enterprise Systems Center at Lehigh University and often involves collaboration among education, industry and government partners to implement new findings. Courses which Dr. Zimmers teaches include computer integrated manufacturing, computer graphics, manufacturing problems, and experimental industrial engineering. Dr. Zimmers also oversees the senior projects. He joined the I.S.E. faculty in 1973.

Education: Ph.D., Industrial Engineering (Lehigh University)
M.S., Industrial Engineering (Lehigh University)
B.S., Mechanical Engineering (Lehigh University)
B.S., Industrial Engineering (Lehigh University)

NEW RESEARCH DIRECTIONS

Modeling and Mitigating Supply Chain Vulnerabilities

Funded by the National Science Foundation
PI: Lawrence V. Snyder

This research project develops and solves models for designing and operating supply chains that are resilient to disruptions. One set of models prescribes optimal strategies for coping with disruptions when the firm has advanced warning that a disruption may occur or that the probability and duration of a disruption has changed. Another set of models examine alternate strategies available to firms facing disruptions, including dual sourcing, emergency sourcing, demand management, and capacity flexibility. These models are formulated and solved using classical inventory theory and Markov decision processes. In addition, this research studies the cascading effect of disruptions in a multi-echelon supply chain. Using a combination of simulation and optimization techniques, the research identifies the vulnerabilities of such a system and develops strategies for placing safety stock inventory within the system to buffer against disruptions. Many of the models developed will be integrated into a freely distributed software package that simulates a multi-echelon inventory system and may be used in both research and classroom settings.

This research will produce a transformative set of models for supply chain design and management that handle risk during the planning stage, rather than the operational one. It aims to transform the way planners think about “optimality” in supply chains by demonstrating that optimal solutions to many problems are not optimal at all in light of disruptions, and that a policy that fails to account for such disruptions can be extremely costly in the long run. Preliminary results suggest that supply chains can be made significantly more resilient to disruptions without large investments in infrastructure or inventory. The models and insights from this research will be useful to planners in industrial settings as well as non-commercial enterprises such as disaster relief agencies and the military.



Space-Time Inhomogeneity and Performance of Large Scale Ad hoc Networks

Funded by the National Science Foundation
PI: Eugene Perevalov

The objective of this research is the study of the problem of efficiency, quality of service and robustness in space- and time-inhomogeneous large scale ad hoc wireless networks. While some progress has been made in understanding the main factors affecting the performance of ad hoc networks, theoretical exploration of the fundamental performance characteristics of realistic networks that possess essential space- and time-inhomogeneity has been largely absent. The simplest examples of space- and time-inhomogeneous systems are the networks with highly non-uniform node density and networks with changes in node membership both of which have practical importance. This research attempts to close this gap and develop a theoretical framework for the analysis of fundamental limitations and performance of such complex large scale ad hoc networks.



Collaborative Research: Exploiting Cyberinfrastructure to Solve Real-time Integer Programs

Funded by the National Science Foundation

PI: Jeff Linderoth Co-PIs: Ted Ralphs, Lehigh University, S. Ahmed, G. Nemhauser, M. Savelsbergh, Georgia Institute of Technology, A. Miller, M. Ferris, University of Wisconsin-Madison

In recent decades, stunning advances in theory, algorithms, and implementation have turned Integer Programming (IP) into a unique computational science—one that attempts routinely to solve problems that are fundamentally intractable. IP's modeling robustness has led to its application in industrial areas, such as supply-chain planning and telecommunication network design, as well as in basic scientific arenas such as statistics, molecular biology, and physics. Due to its success in the area of planning and design, and the ever-increasing availability of real-time data, demand for IP technology that solves real-time operational problems with stringent runtime requirements is increasing rapidly. Such technology has huge potential for addressing difficult operational problems. Its tactical use may dramatically improve airlines' ability to recover from disruptions, significantly enhance the quality of radiation therapy for cancer patients, or provide huge economic benefits by increasing the agility of supply chains. A key characteristic of IPs arising in real-time environments is that consecutive instances typically differ only slightly, which indicates a need for novel IP technology that supports *incremental* problem solving. Breakthroughs in high performance and distributed computing technology have made it possible to harness enormous computational power for the solution of specific problems. Because of the stringent runtime requirements, it is natural to consider designing real-time IP systems that exploit modern cyberinfrastructure. This cross-cutting research effort requires specialists in *cyberinfrastructure* (high performance and grid computing systems), *operations research* (integer programming methodology), and *enterprise applications*. The project team has experts that span these disciplines.

Optimization Under Nonconvexity and Uncertainty: Algorithms and Software

Funded by the Department of Energy—Office of Science

PI: Jeff Linderoth

This project will advance the state-of-the-art in solving large-scale numerical optimization problems. The project's focus is on problem classes that have proven to be among the most challenging for practitioners: those involving uncertainty and those involving nonconvexity. Moreover, the algorithmic advances will be converted into practical software packages and engineered to run on modern, powerful computing platforms.

We focus on the following specific optimization problem classes: *Nonconvex Optimization*: mixed integer nonlinear programming (MINLP) and nonconvex quadratically constrained quadratic programs (NQP). *Stochastic Optimization*: two stage linear (2SLP) and integer (2SIP) recourse problems, variance reduction techniques for sample-path-based optimization (VRSP). We attack these problems by developing new 1) *Algorithms*: dynamic decomposition algorithms for 2SLP, trust-region algorithms and branch-and-price for 2SIP, outerapproximation and branch-and-cut for MINLP, and branch-and-bound for NQP, 2) *Relaxations*: cutting planes for MINLP, nonlinear, second-order cone, relaxations for MINLP and NQP, and 3) *Approximations*: quasi-Monte Carlo and randomized Quasi-Monte Carlo approximations for VRSP.

TECHNOLOGY CENTERS & LABS

Enterprise Systems Center (ESC)

<http://www.lehigh.edu/~inesc/>
 Director: Emory W. Zimmers, Jr., Ph.D.

The Enterprise Systems Center is affiliated with the Industrial and Systems Engineering Department. This multidisciplinary center is committed to fusing student experiential learning with industry value creation. The center also seeks to advance interdisciplinary research and scholarship relating to information technology, new process development, and integrated enterprise systems. Additional research initiatives focus on discovering new methods for collaboration among education, industry and government partners through the use of advanced technology. Emphasis is given to an entrepreneurial approach to problem-solving. The ESC provides undergraduate and graduate students from a variety of university disciplines including engineering, business, education, and the arts and sciences with the opportunity to work on teams with faculty and professional engineers to solve a variety of real world industry problems.

Center for Engineering Logistics & Distribution (CELDi)

<http://www.lehigh.edu/~inceldi/>
 Director: Emory W. Zimmers, Jr., Ph.D.

The Center for Engineering Logistics and Distribution is a partnership between the National Science Foundation and Lehigh University, in which the driving force is to increase cooperation between industry and academia, as well as the public and private sectors. This partnership strives to increase the U.S. competitive edge in the global marketplace. CELDi states its formal mission as: "Providing integrated solutions to the complex global logistics challenges facing U.S. industry." The focus of the Pennsylvania Center at Lehigh University is on agility applications in manufacturing logistics and distribution centers. Emphasis is on manufacturing plant logistics such as material handling, scheduling, lead-time reduction, and applications of information systems for operations management. In addition to Lehigh in the northeast, there are several other geographically dispersed academic partners and over twenty-four industry partners involved nationally.



Center for Value Chain Research (CVCR)

<http://www.lehigh.edu/~inchain/>
 Directors: Lawrence V. Snyder, Ph.D., Susan A. Sherer, Ph.D.

The objective of Lehigh University's Center for Value Chain Research is to foster collaboration with industry on research projects that focus on planning and development of value chains. A value chain is a network that creates customer value, increases profitability, and/or reduces costs, often comprising multiple firms in complex relationships and diverse activities within a single firm. The CVCR is jointly sponsored by the P.C. Rossin College of Engineering and the College of Business & Engineering, and this inter-college collaboration provides a unique, multidisciplinary approach to value chain research, integrating analytical and quantitative engineering approaches with process-driven and field-based business research. The CVCR's member companies include Agere, Boeing, Hewlett-Packard, Air Products, BOC Gases, General Motors, and IBM.



Computational Optimization Research @ Lehigh (COR@L)

<http://coral.ie.lehigh.edu>

*Directors: Rosemary T. Berger, Ph.D.,
Jeffrey T. Linderoth, Ph.D., Ted K. Ralphs, Ph.D.*

Building on the growing interest and expertise in computational optimization, COR@L was created to support continued growth in research and educational activities and to encourage synergy among faculty and students working in computational optimization. Within COR@L, graduate students are developing new software and methodology for solving important problems in application areas such as supply chain optimization, telecommunications network design, transportation and logistics, homeland security, financial engineering, and computational biology. COR@L currently distributes more than half a dozen software packages developed by its members at Lehigh and provides numerous other resources to the research community, including research papers, tutorials, course materials, and data sets. Since its web site went live in February 2005, hundreds of researchers and practitioners across the country and around the world have downloaded software developed at COR@L to help them solve their optimization problems.

George E. Kane Manufacturing Technology Laboratory

Director: Mikell P. Groover, Ph.D.

The George E. Kane Manufacturing Technology Laboratory (named after Professor George Kane who established the laboratory in 1957) focuses on equipment, work systems, machinery, and automation systems for today's manufacturing environment. Its purpose is to provide students the opportunity to acquire hands-on experience in the use of the engineering equipment, systems, and tools in the lab. Current and recent research projects in the lab include the machine ability of powder metal parts, studies of several nontraditional machining processes, creep feed grinding, and rapid prototyping.

The Automation and Robotics Laboratory

Director: Nicholas G. Odrey, Ph.D.

The Automation and Robotics Laboratory, established in 1981, occupies approximately 1500 square feet and contains industrial robots used for various applications. A flexible automation cell is also a focus of the laboratory. Research aspects include the intelligent control of discrete event dynamic systems as well as issues related to intelligent robots. Such research is directed to solving real-world applications. The second laboratory space occupies approximately 500 square feet and contains teaching robots in addition to serving as a sensors and software development laboratory. In addition to being a resource for the I.S.E. department, it has also supported various special project courses and senior design projects of other departments at Lehigh.

The Electrical and Electronics Manufacturing Laboratory

Director: Gregory L. Tonkay, Ph.D.

The Electronics Manufacturing Laboratory (EML), is utilized as both a teaching and research facility. Established in 1991 and occupying approximately 800 square feet, it contains the basic equipment required to design and produce printed circuit boards, populate them with components, solder the components into place, and inspect and test the finished board. Equipment is also in place to produce thick film ceramic hybrid circuits. The mission of this lab is to enhance the learning of undergraduate and graduate students in the processes required to produce electronic assemblies.

RESEARCH GRANTS

GOVERNMENT

Gardiner, Keith M., *PITA IX: Increasing Science and Engineering Pathways Through Research for Grades 6-12*, Pennsylvania Department of Community and Economic Development, September 2005 – August 2006, \$20,900.

Hartman, Joseph C., *CAREER: Large-Scale Parallel Replacement Analysis*, National Science Foundation, August 2000 – June 2005, \$278,000.

Hartman, Joseph C., Louis J. Plebani, Andrew M. Ross, Gregory L. Tonkay, *Integrating the Engineering Curriculum*, National Science Foundation, August 2005 – August 2006, \$100,000.

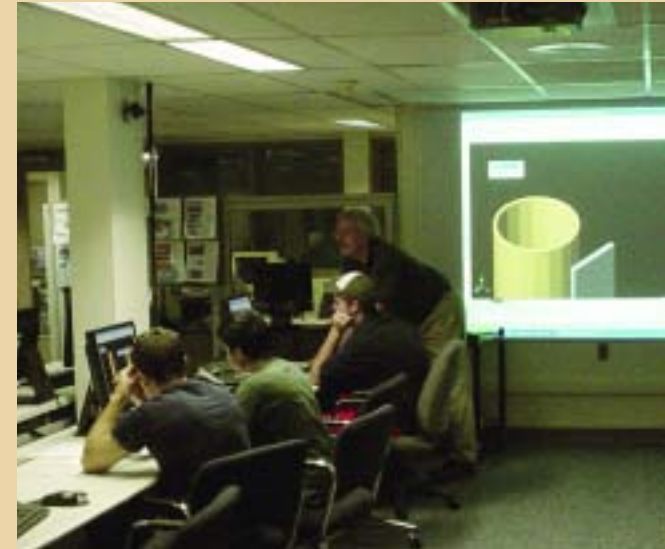
Linderoth, Jeff, *Optimization Under Nonconvexity and Uncertainty: Algorithms and Software*, Department of Energy – Office of Science, August 2005 – August 2008, \$230,637.

Linderoth, Jeff, with S. Wright and M. Livny, University of Wisconsin-Madison, *Collaborative Research: MW: Master-Worker Middleware for Grids*, National Science Foundation, September 2003 – August 2006, \$209,700.

Linderoth, Jeff, with **Ted Ralphs**, Lehigh University, S. Ahmed, G. Nemhauser, and M. Savelsbergh, Georgia Institute of Technology, and A. Miller and M. Ferris, University of Wisconsin-Madison, *Collaborative Research: Exploiting Cyberinfrastructure to Solve Real-Time Integer Programs*, National Science Foundation, September 2005 – September 2008, \$249,161.

Linderoth, Jeff, with I. Grossman, L. Biegler, J. Hooker, Carnegie-Mellon University, *Computational Models and Algorithms for Enterprise-wide Optimization of Process Industries*, Pennsylvania Infrastructure Technology Alliance, April 2005 – April 2006, \$78,588.

Linderoth, Jeff, *Numerical Optimization on a Computation Grid*, Alliance Allocations Board, March 2005, 50,000 CPU hours.



Linderoth, Jeff, *Short Courses in Support of Technology for Process Planning*, Pennsylvania Infrastructure Technology Alliance, November 2005 – March 2007, \$17,219.

Perevalov, Eugene, *Space-Time Inhomogeneity and Performance of Wireless Ad hoc Networks*, National Science Foundation, September, 2005 – July 2008, \$200,000.

Ralphs, Ted, *Scalable Parallel Algorithms for Large-scale Optimization*, National Science Foundation, August 2001 – August 2005, \$205,612.

Ralphs, Ted, *SGER: Duality and Warm Starting*, National Science Foundation, August 2005 – July 2006, \$80,000.

Ralphs, Ted, *PITA VIII – Large Scale Optimization for Routing and Scheduling*, Pennsylvania Department of Community & Economic Development, July 2005 – June 2006, \$50,000.

Snyder, Lawrence V., *Modeling and Mitigating Supply Chain Disruptions*, National Science Foundation, September 2005 – August 2008, \$225,000.



Tonkay, Gregory L., *Integrating the Engineering Curriculum: Careers and Concentrations, Toolboxes and Technology*, National Science Foundation, September 2005 – August 2006, \$100,000.

Wu, S. David, *Integrative Graduate Education and Research Training (IGERT) Program*, National Science Foundation, September 1999 – July 2007, \$2,900,000.

Wu, S. David, *ITR/PE: Supply Chain Coordination*, National Science Foundation, August 2001 – August 2006, \$1,000,000.

Zimmers, Jr., Emory W., *PA Agile Manufacturing Program*, Pennsylvania Department of Community & Economic Development, July 2002 – June 2005, \$750,000.

Zimmers, Jr., Emory W., *PA Agile Manufacturing Program*, Pennsylvania Department of Community & Economic Development, July 2003 – June 2006, \$750,000.

Zimmers, Jr., Emory W., *PA Agile Manufacturing Program*, Pennsylvania Department of Community & Economic Development, July 2004 – June 2007, \$750,000.

Zimmers, Jr., Emory W., *Methodologies to Enhance Experience-based Manufacturing Curricula Preparing Disadvantaged Youth for Life-Long Employment*, U.S. Department of Labor, April 2000 – December 2005, \$750,000.

Zimmers, Jr., Emory W., *Beta Testing of Reality Experience Tools*, U.S. Department of Labor, June 2002 – December 2005, \$300,000.

Zimmers, Jr., Emory W., *Plating Area Scrubber Systems Improvements*, Tobyhanna Army Depot and Technical Assistance Ben Franklin Technology Partners, July 2004 – June 2006, \$50,000.

Zimmers, Jr., Emory W., *A Proposed Research Site for CELDi: A Multi-Campus I/UCRC*, National Science Foundation, July 2004 – September 2006, \$100,000.

INDUSTRY

Hartman, Joseph C., *Pharmaceutical Portfolio Metrics*, Johnson & Johnson, December 2004 – December 2005, \$15,000.

Hartman, Joseph C., *Equipment Capacity Analysis*, ATAS Corporation, August 2004 – May 2005, \$12,285.

Linderoth, Jeff, *Unrestricted Research Grant*, Air Products & Chemicals, July 2005 – July 2006, \$27,500.

Linderoth, Jeff, *Take or Pay Valuation*, Air Products & Chemicals and The BOC Group, March 2005 – March 2006, \$22,500.

Ralphs, Ted, *Advanced Computational Techniques for Mixed-Integer Programming*, SAS Institute Inc., September 2005 – August, 2006, \$100,000.

Ralphs, Ted, *STTR Phase I: Parallel Algorithms for Route Optimization*, Scalable OR Solutions., January 2005 – December, 2005, \$100,000.

Ralphs, Ted, *IBM Faculty Partnership Program*, International Business Machines, Inc., September 2001 – August 2005, \$90,000.

Snyder, Lawrence V., *Agere FY04-05*, Agere Systems, July 2005 – June 2006, \$50,000.

Snyder, Lawrence V. and **George R. Wilson**, *Strategies for Coping with Supply Chain Disruptions*, IBM Integrated Supply Chain, August, 2005 – July 2006, \$20,000.

GOVERNMENT & INDUSTRY

Linderoth, Jeff, with L. Biegler, Carnegie Mellon University, *A GAMS Interface to IPOPT for Large-Scale Nonlinear Programming*, Air Products & Chemicals and Pennsylvania Infrastructure Technology Alliance, June 2004 – September 2005, \$1,100.

Wu, S. David, Rosemary T. Berger, *Demand Planning and Supply Chain Coordination in the Contract Manufacturing Environments*, National Science Foundation and Semiconductor Research Corporation, September 2004 – September 2007, \$400,000.

Zimmers, Jr., Emory W., *Information Systems Improvements*, Northeast Ben Franklin Technology Partners and Tray Pak, July 2005 – June 2006, \$80,000.

Zimmers, Jr., Emory W., *Warehouse Design and Improvements*, Northeast Ben Franklin Technology Partners and Cambridge Lee, July 2004 – June 2005, \$48,500.

Zimmers, Jr., Emory W., *Operational Process and Productivity Improvements*, Northeast Ben Franklin Technology Partners and Henson, July 2004 – June 2005, \$28,000.

Zimmers, Jr., Emory W., *Operational Process and Productivity Improvements*, Northeast Ben Franklin Technology Partners and Henson, July 2005 – June 2006, \$42,000.

Zimmers, Jr., Emory W., *Operational Process Improvements*, Northeast Ben Franklin Technology Partners and Hofmann, July 2004 – June 2005, \$120,000.

Zimmers, Jr., Emory W., *Operational Process and Productivity Improvements*, Northeast Ben Franklin Technology Partners and Hofmann, July 2005 – June 2006, \$60,000.

Zimmers, Jr., Emory W., *Facility Planning and Operational Improvements*, Northeast Ben Franklin Technology Partners and Summit Steel, July 2004 – June 2005, \$76,000.

Zimmers, Jr., Emory W., *Development of Estimating and Cost Estimating System*, Northeast Ben Franklin Technology Partners and Catawissa, July 2005 – June 2006, \$52,400.

Zimmers, Jr., Emory W., *Operational Process and Productivity Improvements*, Northeast Ben Franklin Technology Partners and Rose Corp, July 2005 – June 2006, \$70,000.

Zimmers, Jr., Emory W., *Operational Process and Productivity Improvements*, Northeast Ben Franklin Technology Partners and Torres & Towers, July 2005 – June 2006, \$15,076.

Zimmers, Jr., Emory W., *Production System Improvements*, Technical Assistance Ben Franklin Technology Partners and Alcoa, July 2005 – June 2006, \$10,000.

Zimmers, Jr., Emory W., *Improved Machine Operation*, Technical Assistance Ben Franklin Technology Partners and Apeeling Fruit, July 2005 – June 2006, \$8,200.

Zimmers, Jr., Emory W., *Gap Analysis for Operational Improvements*, Catawissa and Technical Assistance Ben Franklin Technology Partners, July 2004 – June 2006, \$18,750.

Zimmers, Jr., Emory W., *Production Incentive System*, Penn Summit Tubular and Technical Assistance Ben Franklin Technology Partners, July 2004 – June 2005, \$19,200.

Zimmers, Jr., Emory W., *Product Engineering and Design for Manufacture*, Southeast Ben Franklin Technology Partners and Cook Technologies, July 2004 – June 2006, \$30,000.

Zimmers, Jr., Emory W., *Small Press Process Improvements*, Southeast Ben Franklin Technology Partners and Global Rubber, July 2004 – June 2006, \$14,000.

Zimmers, Jr., Emory W., *Disposable Sanitary CPL*, Southeast Ben Franklin Technology Partners and Omni Systems, July 2004 – June 2005, \$16,000.

Zimmers, Jr., Emory W., *Sanicoater Improvements*, Southeast Ben Franklin Technology Partners and Omni Technologies, July 2004 – June 2006, \$14,200.

Zimmers, Jr., Emory W., *Combination Garden Weeding Tools*, Southeast Ben Franklin Technology Partners and Omni Technologies, July 2005 – June 2006, \$16,000.

Zimmers, Jr., Emory W., *Pearl Carding Equipment*, Southeast Ben Franklin Technology Partners and Brogan, July 2005 – June 2006, \$10,300.

Zimmers, Jr., Emory W., *Work Flow Analysis*, Work Flow Analysis Industry, July 2004 – June 2005, \$198,750.



PUBLICATIONS 2005



Books

EMC2: Engineering Practicum, **E. W. Zimmers, Jr.**, L. R. Butler, W. R. Haller, and R. J. Novotny, Engineering Minor, Lehigh University, E-Source, Prentice Hall Publishers, Fall 2005.

Refereed Chapters in Books or Monographs

"Computational Grids and Stochastic Programming," **J. T. Linderoth** and S. J. Wright, in *Applications of Stochastic Programming, SIAM Mathematical Series on Optimization*, S. Wallace and W. Ziemba (eds.), 2005.

"Noncommercial Software for Mixed-Integer Programming," **J. T. Linderoth** and **T. K. Ralphs**, in *Integer Programming: Theory and Practice*, CRC Press Operations Research Series, J. Karlof (ed.), 2005.

"Robotic Applications," **N. G. Odrey**, in *The Electrical Engineering Handbook, 3rd Edition*, Richard C. Dorf (ed.), CRC Press, 2005.

"Decomposition in Integer Programming," **T. K. Ralphs** and M. V. Galati, in *Integer Programming: Theory and Practice*, CRC Press Operations Research Series, J. Karlof (ed.), 2005.

"Facility Location in Supply Chain Design, Chapter 2," M.S. Daskin, **L.V. Snyder**, and **R.T. Berger**, in *Logistics Systems: Design and Optimization*, Kluwer Academic Publishers, 2005.

"Demand Propagation in ERP Integrated Assembly Supply Chains, Chapter 6," **S. D. Wu** and M. J. Meixell, in *Research Frontiers in Supply Chain Management and Electronic Commerce*, J. Geunes, P. M. Pardalos, H. E. Romeijn, and Z. J. Shen (Eds.), Applied Optimization Series, Springer publishers, 2005.

"Computer Aided Design, Chapter 13," **E. W. Zimmers, Jr.** et al, in *Mechanical Engineers' Handbook, 3rd Edition*, John Wiley & Sons, Inc. publishers, 2005.

Journal Articles

Hartman, J. C., "A note on 'A strategy for optimal equipment replacement,'" *Production Planning and Control*, 16(7): 733-739, 2005.

Wu, P., **J. C. Hartman** and **G.R. Wilson**, "An Integrated Model and Solution Approach for Fleet Sizing with Heterogeneous Assets," *Transportation Science*, 39(1): 87-103, 2005.

Rogers, J. L., and **J. C. Hartman**, "Equipment Replacement under Continuous and Discontinuous Technological Change," *IMA Journal of Management Mathematics*, 16: 23-36, 2005.

Linderoth, J. T., "A Simplicial Branch-and-Bound Algorithm for Solving Quadratically Constrained Quadratic Programs," *Mathematical Programming, Series B*, 103: 251-282, 2005.

Mejia, G., and **N. G. Odrey**, "An Augmented Petri Net Approach for Error Recovery in Manufacturing Systems Control," *Robotics and Computer-Integrated Manufacturing*, 21: 346-354, 2005.

Ralphs, T. K. and M. Galati, "Decomposition and Dynamic Cut Generation in Integer Programming," *Mathematical Programming*, online, 2005.

Ross, A. M. and J. G. Shanthikumar, "A Two-Provider Cost Model," *Queueing Systems: Theory and Applications*, 51(1-2), 2005.

Ross, A. M. and J. G. Shanthikumar, "Estimating effective capacity in Erlang loss systems under competition," *Queueing Systems: Theory and Applications*, 49(1): 23-47, 2005.

Kuntraruk, J., W. Pottenger, and **A. M. Ross**, "Application Resource Requirement Estimation in a Parallel-Pipeline Model of Execution on a Computational Grid," *IEEE Transactions on Parallel and Distributed Systems*, 16(12), 2005.

Oren, S. S. and **A. M. Ross**, "Can we prevent the gaming of ramp constraints?" *Journal of Decision Support Systems*, 40(3-4): 461-471, 2005.

Snyder, L. V., "Reliability models for facility location: The expected failure cost case," *Transportation Science*, 39(3): 400-416, 2005.

James, R. J. W. and **R. H. Storer**, "Techniques for Solving the Subset Sum Problem," *International Transactions in Operational Research*, 12(4): 437-453, 2005.

Wu, S. D., M. Erkoc, and S. Karabak, "Managing Capacity in the High-Tech Industry: A Review of Literature," *The Engineering Economist, Invited Paper for the anniversary celebration of Volume 50*, 50(2), 2005.

Erkoc, M. and **S. D. Wu**, "Managing High-Tech Capacity Expansion via Reservation Contracts," *POM Special Issue on High Tech Production and Operations Management*, 14(2): 232-251, 2005.

Meixell, M. J. and **S. D. Wu**, "Demand propagation in the extended enterprise: A comparative analysis of product and process design policies," *International Journal of Production Research*, 43(20): 4169 - 4189, 2005.

Suleyman, K. and **S. D. Wu**, "Incentive Schemes for Semiconductor Capacity-Allocation: A Game Theoretic Analysis," *POM Special Issue on High Tech Production and Operations Management*, 14(2): 175-188, 2005.

Reviewed Conference Proceedings

Hartman, J. C. and M. J. Russo, "Using 'Real World' Problems in Engineering Economy," *Proceedings of the 2005 American Society for Engineering Education Conference (CD-ROM)*, June, 2004.

Rogers, J. L. and **J. C. Hartman**, "Replacement Analysis under Continuous and Probabilistic Discontinuous Technological Change," *Proceedings of the 14th Industrial Engineering Research Conference*, Atlanta, GA, May, 2005.

Gardiner, K., "The Evolving Production Enterprise," *18th International Conference on Production Research*, Salerno, Italy, July – August, 2005.

Perevalov, E., R. Blum, and D. Safi, "On the Capacity of Ad Hoc Networks with Clustering," *Wireless Communications and Networking Conference*, March, 2005, 632-637.

Perevalov, E., R. Blum, and D. Safi, "Threshold Effect in the Throughput of Large Clustered Ad Hoc Networks," *GLOBECOM Conference*, November – December, 2005.

Perevalov, E., R. Blum, A. Nigara, and X. Chen, "Route Discovery and Capacity of Ad Hoc Networks," *GLOBECOM Conference*, November – December, 2005.

Ralphs, T. K. and M. Guzelsory, "The SYMPHONY Callable Library for Mixed Integer Programming," *Proceedings of the Ninth INFORMS Computing Society Conference*, Annapolis, MD, January, 2005.

Xu, Y., **T. K. Ralphs**, L. Ladanyi, and M. J. Saltzman, "ALPS: A Framework for Implementing Parallel Search Algorithms", *Proceedings of the Ninth INFORMS Computing Society Conference*, Annapolis, MD, January, 2005.

Zimmers, Jr., E. W. and M. Baramichai, "Agile Supply Network Transformation Matrix: A New QFD-Based Tool for Creating an Agile Enterprise," *Proceedings of the 2005 QFD Institute, 17th Symposium on Quality Function Deployment*, Portland, OR, September, 2005.



HONORS

PROFESSIONAL HONORS & SERVICE



Berger, Rosemary T.

- Member, INFORMS: Treasurer - Junior Faculty Interest Group, Cluster Co-Chair - Telecommunications Section for INFORMS Annual Meeting, Selected Participant - Young Researcher Roundtable, Conference on OR/MS Practice
- Member, MPS
- Citation of Excellence, Emerald Management Reviews Independent Review Board, Top Fifty Management Articles of 2004 for "Long-Distance Access Network Design" by R. T. Berger and S. Raghavan
- Session Chair, Integer Programming Applications, 9th INFORMS Computing Society Conference, Annapolis, MD
- Session Chair, Telecommunications Network Design, INFORMS Annual Meeting, San Francisco, CA

Gardiner, Keith

- Chair, Engineers Club of the Lehigh Valley
- Associate Editor, Journal of Manufacturing Systems
- Associate Editor, Journal of Manufacturing Processes
- Member, Board of Advisors Association for Electronics Manufacturing of the Society of Manufacturing Engineers
- Member, ASME Energy & Economics Committee
- Member, Advisory Board and Judge for Future City Competition, Washington, D.C., 2000-2006
- Judge, Eastern Region Pennsylvania Junior Academy of Science
- Judge, Lehigh Valley Science and Engineering Fair
- Judge, Future City Competition Delaware Valley Regional Finals, Villanova

Groover, Mikell P.

- Member & Judge, International Honor Awards Committee, SME
- Member, IIE, SME, ASME, ASM International

Hartman, Joseph C.

- Soteria and George N. Kledaras '87 Chair
- ASEE, Eugene L. Grant Award for Best Paper Published in Volume 49 of The Engineering Economist
- Pennsylvania Society of Professional Engineers, Lehigh Valley Chapter Young Engineer of the Year Award
- Editor-in-Chief, The Engineering Economist
- Editorial Review Board, "Engineering Economy," (Management Systems Division) American National Standard for Industrial Engineering Terminology
- Member, IIE, INFORMS, ASEE, National Society of Professional Engineers (NSPE)
- Registered Professional Engineer, Pennsylvania
- IIE Industrial Engineering Research Conference, Conference Program Planning Committee

Linderoth, Jeff

- Faculty Partnership Award, IBM Mathematical Sciences Department
- Semi-plenary Speaker, Research Center on Software Technology, Italy, 2005
- U.S. Department of Energy Early Career Principal Investigator Award
- Lehigh Engineering Ingenuity Award
- Co-Editor, "Optimization on Grids/Optimization for Grids," Parallel Computing Special Issue (to appear in 2006)
- Associate Editor, Design & Analysis of Algorithms, INFORMS Journal on Computing
- Area Coordinator, Applications, OR, and Management Science, Optimization Online
- Area Coordinator, Integer Programming, Optimization Online
- Area Coordinator, Stochastic Programming, Optimization Online
- Area Coordinator, Robust Optimization, Optimization Online
- Feature article of work in National Center for Supercomputing Applications online newsletter
- Member, INFORMS, MPS, SIAM
- Secretary-Treasurer, INFORMS Computing Society
- Organizing Committees, MIP 2006 Conference, COIN-OR Workshop, DIMACS, IMA "Hot Topics" Workshop: Mixed Integer Programming
- Program Committee, Grid Resource Management Workshop, Poland
- Administrator, Network Enabled Optimization System

Odrey, Nicholas G.

- "Marquis Who's Who," Who's Who in Science and Engineering, 8th Edition, 2005-2006, Providence, New Jersey.
- Associate Editor, Journal of Manufacturing Systems
- Member, SME, ASME

Perevaqlov, Eugene V.

- Member, IEEE

Plebani, Louis J.

- Member, ASEE

Ralphs, Ted

- Associate Editor, Operations Research
- Associate Editor, Operations Research Letters
- Editorial Board, Algorithmic Operations Research
- Member of Strategic Leadership Board, Chair of Technical Leadership Council, Treasurer, Chair of Budget and Legal Affairs Committees, COINS-OR Foundation
- Member, EURO Parallel Processing Working Group
- Member, INFORMS, INFORMS Computing Society, INFORMS Optimization Section, MPS
- Founder & Webmaster, BranchAndCut.org, a website devoted to the application of branch, cut, and price algorithms

Ross, Andrew

- Judge, Pennsylvania Junior Academy of Sciences
- Judge, Lehigh Valley Science Fair
- Member, INFORMS, Mathematical Association of America, American Statistical Association

Snyder, Lawrence V.

- IIE Pritsker Doctoral Dissertation Award, First Place
- Chair, "Location Models with Uncertainty," IIE, Atlanta, GA, May 2005
- Chair, "Supply Chain Disruptions," INFORMS, San Francisco, CA, November 2005
- Member, INFORMS, IIE

Storer, Robert H.

- Distinguished visiting scholar, Frontera University, Temuco, Chile
- Top Paper in Engineering, Lehigh University: "Disturbance Detection and Isolation by Dynamic Principal Component Analysis"
- Member, Editorial Board, IIE Transactions on Quality and Reliability
- Member, INFORMS, IIE

Thiele, Aurélie

- Chair, "Recent advances in dynamic pricing," IFORS triennial meeting, Hawaii
- Chair, "Robust optimization," INFORMS annual meeting, San Francisco, California
- Chair, "Robust revenue management," INFORMS annual meeting, San Francisco, California
- Member, MPS, INFORMS, SIAM

Tonkay, Gregory L.

- 2nd Place Winner, IE Division Best Paper Award, 2003 ASEE Annual Conference
- Distinguished Teaching Award, Lehigh University Christian R. and Mary F. Lindback Foundation
- Member, National Science Foundation Greenfield Coalition Curriculum Committee, CATER
- Member, ASEE, IIE

Wilson, George R.

- Member, INFORMS, IIE

Wu, S. David

- Fellow Award, Institute for Industrial Engineers, 2005
- Eminent Engineer, Tau Beta Pi, The Engineering Honor Society, 2005
- Department Editor, IIE Transactions on Operations Engineering
- Associate Editor, Manufacturing & Service Operations Management
- Chair, "Auctions in the Supply Chain," Auction Theory and Applications, INFORMS National Conference, San Francisco, CA, November, 2005
- International Reviewer, Hong Kong Research Grant Council
- Invited Member, Supply Chain Thought Leaders' Roundtable, Carnegie Bosch Institute
- Member, INFORMS, IIE, Tau Beta Pi, and Sigma Xi

Zimmers, Jr., Emory W.

- 2nd Place Winner, IE Division Best Paper Award, 2003 ASEE Annual Conference
- Fellow, IIE, SME
- Member, ASME
- Member, American Association of University Professors
- Member, Association for Supervision and Curriculum Development

UNDERGRADUATE DEGREES AWARDED



Bachelor of Science, Industrial Engineering

George Berger	Brian McCabe
Kristin Bigach	Brandon Miranda
Kathleen Bove	Archana Misra
Whitney Chen	Scott Morris
Ruth Chu	Adrienne Panos
Donald Fanelli	Olivia Park
Daniel Feith	Joshua Platt
Travis Frick	Justin Rinker
Christopher Gerlach	Bryan Romano
Daniel Greenawalt	Rodolfo Schildknecht
Ryan Haworth	Carolyn Sneeringer
Yan Jin	Scott Sosin
Matthew Jones	Thomas Varghese
Eric Jung	Arleigh Waring
Marissa Just	Adam Weinstein
Kelly Kennedy	Allison Leigh Williams
Amy Komarinetz	Jeremy Wilson
Kurt Lesker IV	Maureen Wink
Margaret Lucey	Ahmet Yetis

Bachelor of Science, Information & Systems Engineering

Joseph Badalamenti
Jacqueline Griffin
Jesse Powell
Ramon Pressburger, Jr.
Meredith Somers
Ashwin Uttamchandani
Omer Yonder

Bachelor of Science, Integrated Business & Engineering (Industrial Engineering)

Amanda Ecker
Michael Monaco
Julie Prior
Scott Roth
Christopher Salter
Scott Sosin
Charles Williams

Bachelor of Science, Integrated Business & Engineering (Information & Systems Engineering)

Eric Eng

GRADUATE DEGREES AWARDED

Master of Science, Management Science

Zeliha Akca
Christopher Bzik
Douglas Coburn
Thomas de Marffy
Cory Mingelgreen
Jill Morley
Christopher Norberg
Clifford Prescott
Taylor Shapiro
Jerry Shen
Nursen Ulker
Alper Uygur
Esra Yavuz

Master of Science, Quality Engineering

Joseltio Gonzalez
Kelly Hoffner

Master of Science or Master of Engineering, Industrial Engineering

Chun-Lung Chen
Eric Cloyd
David Drake, Jr.
Matthew Jaffe
Udom Janjarassuk
M. Michael Metcalf
Li-Jen/Eric Tsao

Master of Science, Information & Systems Engineering

Christopher Cassin
Kathryn Lausch
Sabrina Terrizzi
Jin Zhen

Master of Business Administration & Industrial Engineering

Sing Peter Choi
James Reinbold

Ph.D., Industrial Engineering

Tarek Al-Hawari
Joao Goncalves
Dorid Mustafa
Clara Novoa
Serkan Ozkan
Thomas Perry
Jennifer Rogers
David Schweitzer
Qunhong Tang

ISE UNDERGRADUATE & GRADUATE STUDIES

Industrial engineering has expanded from its roots in manufacturing to comprise the service industry—transportation, logistics and financial institutions—and now information systems. Lehigh’s department of Industrial and Systems Engineering (ISE), one of the oldest in the United States, has led much of this transformation. We offer a number of different programs to meet the needs in these various industries and setting.

Undergraduate

B.S. in Industrial Engineering

Four specialty areas are offered within this curriculum: manufacturing systems and processes, operations research, information and systems engineering, and production and operations management.

B.S. in Information and Systems Engineering

This program provides rigorous training in quantitative and computational analysis skills. It focuses on three core areas: information economics, quantitative systems analysis, and information technology. These core areas are coupled with general engineering and business background courses.

B.S. in Integrated Business & Engineering

Jointly offered between the College of Engineering & Applied Science and the College of Business, the program recognizes the need for a solid understanding in both commerce and technology. It develops competencies that require an integrated knowledge from both the engineering and business disciplines.

Graduate

Masters in Information & Systems Engineering

This program integrates the understanding of problems with their solutions and implementation using the latest computing and communications technology. There are three core areas to choose from: information economics, quantitative systems analysis, and information technology.

Masters in Management Science

The focus here is on quantitative decision-making for a variety of business applications. Students can choose from topic areas in operations research, decision and risk analysis, economics and cost analysis, production and operations management, and logistics and supply chain management.

Masters in Industrial Engineering

This is the core departmental degree which allows for studies in operations research, manufacturing systems, manufacturing processes, or production management.

Masters in Quality Engineering

This program is a focused degree which applies statistical methods to the control of various systems. Courses focus on applied statistics, quality control, and design of experiments.

Masters in Analytical Finance

This program is ideal for those interested in a career in financial services, whether it’s Wall Street, banking, or insurance. It provides tools in creating innovative solutions for financial problems using state-of-the-art analytical techniques and computing technologies. The program is jointly offered with the math and finance departments.

Ph.D. in Industrial Engineering

Organized to meet the individual goals and interests of graduate students whose professional plans include teaching, industry, consulting, or research, the program involves independent research through the preparation of a dissertation related to a specialized field. Core areas of study include: financial engineering, information systems, manufacturing, production and logistics, optimization, and stochastic processes and applied statistics.

CONTACT INFORMATION

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