Annual Report 2009

Industrial and Manufacturing Systems Engineering

KANSAS STATE UNIVERSITY

Contents

Message from the Department Head

Dear Colleagues and Friends,

I am pleased to provide you with the second annual report of the Kansas State University Department of Industrial and Manufacturing Systems. Our intention is to not only offer the hard data that indicates achievement and impact, but also to share the context in which we operate.

The IMSE department has been educating young engineers for more than a half century. In the early years of K-State's engineering college, our emphasis was on shop practice. In 1937, the industrial arts department was established, and by 1954 the department was renamed industrial engineering and industrial arts. Kansas State University has been granting industrial engineering degrees since that time. Over the years, we have maintained a hands-on, project-oriented research and education experience. While still stressing manufacturing processes and systems, today we increasingly emphasize the application of industrial engineering to service industries, especially health care systems.

In this issue we highlight contributions to manufacturing, specifically those of Zhijian (ZJ) Pei. Manufacturing research is critical to our society. New materials require new tools and processes. Worldwide consumption of goods continues to increase. Though manufacturing employment may decrease with increases in productivity, there will always be a need for experts who understand the transformation of materials from one form to another. Of particular interest in this issue is how Dr. Pei is using his manufacturing expertise to "manufacture energy."

Our department employs 11 faculty members, nine of whom have research assignments. During 2009, the K-State IMSE faculty authored 29 journal articles and 22 articles in refereed conference proceedings. IMSE extramural grant expenditures exceeded $1.75M. Our faculty also served in editorial positions on 28 journals.

In the fall, our programs enrolled 161 B.S., 32 M.S., and 13 Ph.D. students. We also offer two distance education master's programs for working professionals. The first is the master of science in operations research provided under contract to the U.S. Army. The second is a master of engineering management provided to working professionals across the nation. Both programs fit our on-campus offerings and continue to grow. We have also created a concurrent B.S./M.S. degree program that attracts some of our top undergraduate students into our graduate program. These students have proven to become highly productive researchers.

Please feel free to contact me about anything you read in this annual report. You may also want to check us out on the Web at *www.imse.ksu.edu.*

Regards,

Bradley A. Kramer

Bradley A. Kramer, Ph.D.
Professor and Head, IMSE
Ike and Letty Evans Engineering Chair
Director, Advanced Manufacturing Institute

Zhijian Pei: Energy manufacturing

Zhijian (ZJ) Pei, professor of industrial manufacturing systems engineering at Kansas State University, is a manufacturer at heart and he's applying his processes to a new field of research: biofuels.

Since arriving at K-State in 2000, Pei has published 65 papers in scholarly journals and 48 papers in peer-reviewed conference proceedings, had five Ph.D. and five M.S. students graduate, and is currently working with seven graduate students and three undergraduate students on various research projects. His work has been funded with more than $3 million in extramural grants. Among these are $2.1 million in grants from the National Science Foundation (NSF), including the NSF CAREER award in 2004, and more than $800K in industrial and national laboratory grants. He has served on NSF review panels each year, reviewed papers for various journals and served on editorial boards of nine scholarly journals.

Pei also initiated a workshop in 2004 to help others learn how to write competitive proposals for the NSF CAREER program, with support from NSF. Since then, he has organized such workshops every year in several different locations across the U.S. More than 700 young faculty members have attended these workshops.

His primary research areas are grinding of semiconductor wafers and rotary ultrasonic machining of difficult-to-machine materials. Pei has recently taken his expertise in developing new manufacturing processes for physical products such as semiconductor wafers and applied it to converting biomass into energy. In his view, manufacturing is simply the transformation of material from one form to another.

The goal of this exploratory and high-risk research is to develop innovative, cost-effective algae production . . .

This view led to his NSF-sponsored exploratory research on solid carriers used to grow algae in the ocean for manufacturing of algae biofuels. Pei teamed up with Wenqiao Yuan, assistant professor of biological and agricultural engineering at K-State, to address growing energy costs and environmental concerns associated with traditional fuels, by researching biofuels from renewable resources.

Pei is currently focused on generating alternative fuels from algae. Algae can grow in fresh or salty water. Certain species of algae are high in oil content and that content could be converted into fuels like biodiesel. Algae can also produce up to 10,000 gallons of oil per acre, per year, which is more than 500 times more than corn can produce in the same amount of space and time. Furthermore, growing algae eliminates the conflict between food and fuel uses that other crops like corn have to overcome.

The goal of this exploratory and high-risk research is to develop innovative, cost-effective algae production processes in the ocean for manufacturing of algae biofuels. Pei and Yuan hope to determine the optimum material type for solid carriers—one that can float in the ocean and allow algae to attach to and grow on it.

As the algae research moves steadily forward, Pei has also embarked on more research concerning manufacturing of biofuels. His research on ultrasonic vibration-assisted (UV-A) pelleting of cellulosic biomass aims at cost-effective manufacturing of cellulosic biofuels. Pei has received an NSF grant to conduct this research, collaborating with Professor Donghai Wang, also in the biological and agricultural engineering department at Kansas State.

Use of biofuels produced from cellulosic biomass—the fibrous, woody and generally inedible portions of plant matter—may benefit the environment and help lower consumer costs. However, there are several technical barriers to cost-effective manufacturing of cellulosic biofuels. Low-density cellulosic feedstocks are expensive to transport, and storage and the pretreatment process itself is costly. Pei and his students have shown that UV-A pelleting can increase biomass density and sugar yield.

Pei and his students will investigate the effects of ultrasonic vibration on pelleting mechanisms and test various theories related to pelleting of sorghum stalks, switchgrass, wheat straw, corn stover, Miscanthus and grass clippings.

Besides growing algae in the ocean using solid carriers and pelletizing cellulosic biomass for biofuel manufacturing, Pei developed and taught a new graduate course, "Energy Manufacturing," in spring 2010, and is developing and will teach a new undergraduate course "Green Energy Manufacturing," in fall 2010.

"Dr. Pei continues to actively seek out new avenues to apply manufacturing expertise, both in his research and in educating tomorrow's leaders," said Bradley Kramer, IMSE department head and professor. "He is an outstanding member of our faculty who is truly making a positive impact on our students, his discipline, our profession, and the world."

Faculty

Bradley A. Kramer
Department Head and Professor

Dr. Kramer is professor and head of the industrial and manufacturing systems engineering department, director of the Advanced Manufacturing Institute (AMI), and holds the Ike and Letty Evans Engineering Chair at Kansas State University. His current effort is focused on building efficient means for accelerating collaborative university and industry innovation. Dr. Kramer joined the faculty in 1985.

Education:
- B.S. (Kansas State University)
- M.S. (Kansas State University)
- Ph.D. (Kansas State University)

David Ben-Arieh
Professor

Dr. Ben-Arieh concentrates mainly on applications of decision theory and operations research in the area of health care delivery systems and product development. He teaches courses in the area of production and inventory control and health care systems and conducts research in these areas. His interests include DEA modeling, risk-mitigation techniques and information system modeling. His industrial experience includes working for AT&T Bell Laboratories, and consulting for the aerospace industry and health care organizations. Dr. Ben-Arieh joined the faculty in 1990.

Education:
- B.S. (Ben-Gurion University, Israel)
- M.S. (Ben-Gurion University)
- Ph.D. (Purdue University)

Shing I. Chang
Associate Professor

Dr. Chang serves as chair of undergraduate committee. His research interests include multivariate statistical process control, nonlinear profile monitoring, neural networks and fuzzy set applications in quality engineering, short-run SPC, ISO 90000 documentation system, experimental designs, Taguchi methods and quality diagnosis. He teaches courses related to quality engineering at both undergraduate and graduate levels. Dr. Chang joined the department in 1991.

Education:
- B.S. (Tsing-Hua University, Taiwan)
- M.S. (Arizona State University)
- Ph.D. (Ohio State University)

Kimberly Douglas-Mankin, P.E.
Associate Professor
Director, Women in Science and Engineering Program

Dr. Douglas-Mankin is the director of the Women in Science and Engineering Program and holds the Spainhour Family Chair. Her research focuses on the development and assessment of effective strategies for K-12 outreach, recruitment and retention of engineering and science students, particularly those who are under-served and under-represented in these fields. Dr. Douglas-Mankin is a licensed professional engineer. When she served in a more traditional faculty role, her teaching and research focused on management systems engineering, transportation engineering, quality management, performance assessment and engineering economics. She joined the faculty in 2003.

Education:
- B.S. (Oklahoma State University)
- M.S. (Oklahoma State University)
- Ph.D. (Arizona State University)

Todd Easton
Associate Professor

Dr. Easton performs research in discrete optimization with an emphasis in integer programming and graph theory. His current research in integer programming focuses on finding improved techniques to solve integer programs. In particular, he has developed fast techniques to perform exact simultaneous uplifting for sets of binary variables. His graph theory research develops algorithms and heuristics to solve computationally challenging problems. Lately, he has been modeling and optimizing the response to the spread of an epidemic in rural Kansas. Dr. Easton joined the faculty in 2001.

Education:
- B.S. (Brigham Young University)
- M.S. (Stanford University)
- Ph.D. (Georgia Institute of Technology)

John R. English
Dean

Dr. English is dean of the College of Engineering, professor of industrial and manufacturing systems engineering, and holds the LeRoy C. and Aileen H. Paslay Chair in Engineering at Kansas State University. His research interests include quality control, reliability engineering and applied statistics. He has numerous journal articles in these areas. He is a registered professional engineer in the state of Arkansas and a fellow IIE. Dr. English joined the faculty in 2007.

Education:
- B.S. (University of Arkansas)
- M.S. (University of Arkansas)
- Ph.D. (Oklahoma State University)

R. Michael Harnett
Professor

Dr. Harnett's interests center on large-scale systems modeling and optimization. He teaches courses in operations research, nonlinear programming, theory of decisions and games, and reliability theory. He joined the faculty in 1988.

Education:
- B.S. (Louisiana Polytechnic Institute)
- M.S. (University of Alabama)
- Ph.D. (University of Alabama)

E. Stanley Lee
Professor

Dr. Lee's research interest is primarily in the optimization and systems analysis area such as intelligent and soft computing, uncertainty reasoning, support vector machines and neural-fuzzy computing, fuzzy logic, probabilistic approaches and evidence theory. Another aspect is the applications of these techniques to solve various engineering and social problems such as water resource management, alternative energy developments, pollution and environmental systems, and the efficiency of nonprofit and profit organizations. Dr. Lee teaches courses in optimization theory, queuing, operations research and production, and inventory control. Dr. Lee joined the faculty in 1966.

Education:
- B.S. (Chung-Cheng Institute of Technology)
- M.S. (North Carolina State University)
- Ph.D. (Princeton University)

Faculty

Faculty

Shuting Lei
Associate Professor

Dr. Lei's research interests include machining of difficult-to-machine materials such as structural ceramics, titanium alloys, superalloys and composites; laser-assisted machining of ceramics; femtosecond laser micromachining; numerical modeling of manufacturing processes; and development of novel cutting tools. He teaches courses in manufacturing. Dr. Lei joined the faculty in 1999.

Education:
- B.S. (Tsinghua University, China)
- M.S. (Tsinghua University)
- Ph.D. (Purdue University)

ZJ Pei
Professor

Dr. Pei's research interests include semiconductor wafer manufacturing processes, traditional and nontraditional machining processes, subsurface damage measurement in machined surfaces and energy manufacturing. He teaches manufacturing processes and systems, semiconductor manufacturing processes, product and process engineering, nontraditional machining processes, lean manufacturing and Six Sigma. Dr. Pei joined the faculty in 2000.

Education:
- B.S. (Zhengzhou Institute of Technology)
- M.S. (Beijing Institute of Technology)
- Ph.D. (University of Illinois at Urbana-Champaign)

Malgorzata J. Rys
Associate Professor

Dr. Rys' research interests include the human element in transportation systems, visibility and retro-reflectivity, rumble strips design and performance, roundabouts design and performance, modeling and simulation of natural disasters, transportation logistics, experimental design and benefit-cost analysis. She teaches courses in human factors engineering/ergonomics, design of experiments and engineering economy. Dr. Rys joined the faculty in 1989.

Education:
- B.S./M.S. (Tech. University of Wroclaw, Poland)
- M.S. (Kansas State University)
- Ph.D. (Kansas State University)

Chih-Hang (John) Wu
Associate Professor

Dr. Wu's interests include mathematical programming, network optimization, applied operations research, transpiration and air traffic systems, digital image processing, pattern recognition, material handling, robot control strategy, flexible manufacturing systems design, group technologies and machine loading. Dr. Wu joined the faculty in 1993.

Education:
- B.S. (National Cheng Kung University, Taiwan)
- M.S. (Pennsylvania State University)
- Ph.D. (Pennsylvania State University)

Adjunct Faculty

Kelly Easton

Dr. Easton's area of focus is in operations research with an emphasis in discrete optimization. She was employed as a research associate at Barclays Global Investors, 1994–1996, where she developed nonlinear optimization models and a GUI for financial research. She is currently employed by The Sports Scheduling Group where she develops sports schedules for various college conference and professional leagues.

Education:
- B.A. (Johns Hopkins University)
- M.S. (Stanford University)
- Ph.D. (Georgia Institute of Technology)

Graham Fisher

Dr. Fisher is currently director of intellectual property at MEMC Electronic Materials Inc. He joined MEMC in 1985 and has held various positions including chief scientist, director of operations technology, technical operations manager, and applications engineering manager. His most recent research interests have centered on silicon materials and manufacturing science; developing robust, high-throughput manufacturing processes for silicon wafers for the semiconductor; and solar industries.

Education:
- B.Sc. (University of Salford, England)
- Ph.D. (University of London, England)

Young-Jou Lai

Dr. Lai is a senior forecast modeler of supply chain management at the Halliburton Company. He also serves as an associate editor of the International Journal of Revenue Management. His recent professional interests are in the area of forecasting, optimization, planning/scheduling, inventory control, and risk management with focus on modeling visualization, system development and automation in a global operational environment.

Education:
- B.S. (National Cheng Kung University, Taiwan)
- M.S. (Kansas State University)
- Ph.D. (Kansas State University)

Jiangang Sun

Dr. Sun is a mechanical engineer in the nuclear engineering division at Argonne National Laboratory. His current research interests are in nondestructive evaluation (NDE) technologies including optical scanning, infrared thermal imaging, ultrasonic scanning and x-ray imaging for characterization of advanced materials and manufacturing processes. He has also conducted research in computational thermo-hydraulic analysis for nuclear reactor systems and in multiphase flow and heat transfer processes.

Education:
- B.S. (University of Science and Technology of China)
- M.S. (University of Illinois at Urbana-Champaign)
- Ph.D. (University of Illinois at Urbana-Champaign)

RESEARCH

Research

Convex fuzzy systems and optimization

The definitions of convex and concave functions for crisp systems are too restrictive to apply to fuzzy or more general systems. Several new concepts in this area have been proposed. These new concepts can be used to promote more concise optimization theories, based on these convex and concave theories for fuzzy systems, which are parallel to the Karush-Kuhn-Tucker theory for classical systems.

Fuzzy interactive, multilevel decision making

Multilevel optimization plays an important role in decentralized planning for organizations in which decision makers are arranged at hierarchical levels, and is a very useful tool for large organizations such as government policy, economic systems, transportation networks, etc. Since the problem is basically fuzzy and not well defined, fuzzy approach appears to be ideally suited to improve the basic multilevel approaches. A book has been published in this area: *Fuzzy and Multi-Level Decision Making: Interactive Computational Approach*, Springer-Verlag, London (2001). Another book to solve the multi-level problem based on evolutionary concepts is in the development stage.

Fuzzy data envelope analysis

Data envelope analysis (DEA), based on linear programming, has proven to be a highly useful tool for comparing and improving the efficiencies of non-profit and very large organizations such as hospitals and educational institutions. But, the basic systems of such nonprofit organizations are vague and not well defined. Thus, a fuzzy approach can help to overcome some of the problems in applying DEA. A book in this area will be published by IGI-Global, entitled *Fuzzy Data Envelopment Analysis: Technologies, Concepts and Applications*.

Artificial life

An interdisciplinary research area, artificial life intends to combine various disciplines such as artificial intelligence, neural network, fuzzy sets, psychology, and humanistic aspects to study or to model the living systems or human-level artificial systems or machines that exhibit intelligent autonomous behavioral characteristics of human or living systems. At the same time, IGI-Global published a journal on artificial life research.

Applied soft computing

Fuzzy neural network, known as fuzzy adaptive network (FAN), and support vector machines are used to model not-well-defined, vague, or humanistic systems such as thermal comfort, human fatigue, presidential elections, financial credit ratings, soft-pad grinding in manufacturing, cell formation in cellular manufacturing, etc.

Human factors engineering in transportation

This research project, which focuses on the effectiveness of different lane-departure systems, specifically centerline rumble strips (CLRS), was sponsored by the Kansas Department of Transportation and University Transportation Center. “Promoting Center-Line Rumble Strips to Increase Rural, Two-Lane Highway Safety” addressed some of the major concerns with CLRS that could prevent their widespread use and thus affect safety for the driving population. One of the major concerns, and a possible drawback, of CLRS is an unacceptable level of noise to roadside residents. The goal of the project is to develop a model that predicts the amount of external noise produced by vehicles crossing over the center line.

This model will help state agencies to select the least-intrusive design of CLRS, improve its acceptance, and thus improve safety on rural roadways. As part of the study, rigorous before-and-after crash studies were preformed using Naïve and Empirical Bayes methods. Another project addresses concerns over whether CLRS causes hydroplaning.

The main objective of a project, “Effectiveness of Larger Traffic Signs, High-Performance Sheeting, and Clearview Font on Accident Reduction,” sponsored by the University Transportation Center, is to determine typical locations and/or scenarios where bigger signs are effective in reducing accidents on rural/urban roads.

Manufacturing of biofuels

Growing concern over limited petroleum resources, environmental impacts and national security has stimulated broad interest in producing and utilizing biofuels (e.g., biodiesel and ethanol) from domestic biomass resources. Collaborating with faculty in the department of biological and agricultural engineering, we are working on manufacturing-related issues in producing biofuels from algae and cellulosic biomass.

Health care initiatives

The heath care focus is in its third year and has established quite a few accomplishments. Indications to this are projects such as the modeling of the progression of sepsis (acute systemic infectious response) in the body at a cellular level using system dynamics and computer simulation. The aim is modeling this phenomenon at a more aggregate level using advanced parallel simulation mechanisms, thus allowing acute care personnel or care managers to predict the status or risk of a patient during an episode of care. This will help to make best use of resources on patients that are at a higher risk of developing sepsis shock. The project is conducted with a close collaboration with the University of Kansas Medical School Hospital.

Another project uses data envelopment analysis (DEA) methodology to assess the effectiveness of safety-net clinics in the state of Kansas. The Center of Engagement and Community Development funded the project. This research focuses on assessing the effectiveness, core competencies and weaknesses of individual clinics regardless of size, location or community served. In addition, the project will study the differences between clinics that are state funded vs. unfunded ones, and clinics in rural areas vs. urban clinics.

In addition to the research-oriented projects, we have been continuously involved with more service-oriented projects that provide support to the local health care industry. Such projects include facility planning design and analysis, information systems support, improving patient flow, reducing patient waiting times and enhancing patient safety.

A health care advisory council consisting of state officials, hospital administrators, physicians, insurance companies and non-profit health care organizations was formed in 2007 to oversee our diversified efforts in outreach, research and community engagements. In addition, the council has been providing valuable suggestions, recommendations and help to develop strategic plans for future directions.

Machining advanced materials

Our objectives in this research area are (i) to advance the fundamental knowledge of machining advanced materials at both macro and micro scale through numerical modeling and processes, and (ii) to develop laser-assisted machining and laser micromachining processes and advanced cutting tool technologies to enable high-performance machining techniques for difficult-to-machine materials. One current research focus is laser-assisted machining of ceramics. Ceramic materials such as structural ceramics, bioceramics and ceramic matrix composites are hard and brittle. They are difficult to shape using conventional machining processes. Laser-assisted machining is being developed to machine these materials in a cost-effective way. We are also actively working on femtosecond laser micromachining research, currently funded by DoD and NSF in collaboration with the physics department of Kansas State University, the mechanical engineering department of Illinois Institute of Technology and our industrial partner – Caterpillar, Inc. With high-intensity, ultra-short pulses from the femtosecond laser, we try to develop new laser machining techniques for creating features in both micro and nano scale for a variety of materials.

Discrete optimization

We are currently performing research in discrete optimization with an emphasis in integer programming and graph theory. This integer programming research focuses on finding improved techniques to solve integer programs. Our graph theory research develops algorithms and heuristics to solve computationally challenging problems.

The bulk of our recent integer programming research uses feasible integer points to generate valid inequalities and facet-defining inequalities. This technique has led to numerous new results in integer programming, including development of the first algorithm to simultaneously lift sets of general integer variables, a new way to perform sequential lifting, polynomial time methods to simultaneously lift numerous inequalities into a cover inequality and discovering a new class of facet-defining inequalities called three-set inequalities for the knapsack polytope.

The most recent research in graph theory primarily revolves around modeling the spread of infectious diseases. This research has received funding from the National Science Foundation. Another aspect we are proud to announce is the formation of EPICENTER at Kansas State, which seeks to model and describe the spread of epidemics. This research has developed a core simulation software package, which can be applied to specific instances of certain diseases. The ultimate goal of this research is to use integer programming and graph theory concepts to devise methods and policies to contain the spread of an infectious disease so that the impact of such an unfortunate event is as small as possible.

Laser-scattering measurement of subsurface damage in machined surfaces

For semiconductor wafer manufacturing, subsurface damage induced by mechanical machining processes must be removed by subsequent processes. However, current subsurface damage characterization methods are mostly destructive, time consuming and expensive. There are no nondestructive evaluation methods that can provide subsurface damage information across the whole wafer. Lack of such tools has hindered further reduction in manufacturing costs of semiconductor wafers and integrated circuits. Collaborating with Dr. JG Sun at Argonne National Laboratory, we developed two laser-based

techniques, an improved laser-scattering method and an innovative cross-polarization confocal-microscopy method.

Machining of semiconductor wafers

Semiconductor devices are found almost everywhere—in computers, cell phones, televisions, automobiles and airplanes. More than 90 percent of the semiconductor devices in use today are built on silicon wafers. We are using finite-element analysis and theoretical modeling to develop grinding parameters for cost-effective silicon-wafer manufacturing. Progress in this research area will mean decreased cost of silicon wafers and semiconductor devices.

Rotary ultrasonic machining of hard-to-machine materials

Using rotary ultrasonic machining, we develop new drilling methods for hard-to-machine materials such as advanced ceramics, titanium, stainless steel and composites. Many components made from these materials require drilling operations. However, these materials are notorious for their poor machinability, resulting in high cost and low efficiency with current drilling methods. Therefore, there is a critical need to develop more cost-effective drilling processes for these materials. Research in this area has been supported by Boeing, Sonic Mill and NBR Diamond Tool.

Ultra-precision, non-contact surface strain measurements

The main objective of this multi-department (civil, mechanical and industrial engineering) research effort is the development of ultra-precision, non-contact measurement techniques to measure dynamic changes on the surface strains in a variety of real-world applications, including bridge inspection, pre-stress concrete elements manufacturing, semiconductor wafer surface strains measuring and metallic structure dynamic stress. Previous research efforts have shown that by recognizing the tiny shifts of the fringes or speckle patterns reflected by the measured surfaces, precise surface strain changes can be calculated mathematically using sophisticated digital-imaging processing algorithms and their corresponding domain transformations.

Our objective is to dynamically measure pre-stressed concrete element distension processes using low-cost, high-precision but rugged optical devices that can be used by field engineers. Various innovative image-processing algorithms and optic design processes based on nonlinear optimization and matrix factorization are used for calculating image correlations and peak-findings processes. We were able to use fundamental operations research techniques to enhance the speckle resolution tenfold. Therefore, it was possible to use low-cost hardware (camera and optical components) to achieve a high measure of precision.

In recent work, we revamped this development to work with general surfaces, including rough (concrete, papers, textured) and smooth (metal, semi-conductor wafers and polished) surfaces, using a single unified device while maintaining +/-15 m-strains of accuracies (i.e., 1.5x10-5 of the effective measuring spans). Robust optimization design models were used to efficiently identify the sensor repositioning processes and determine the speckle images' capture on the fly. Second-generation prototype devices are currently being extended to perform two-dimensional strain measurement and surface-stress structure studies.

Profile analysis for multivariate statistical process control

Traditional statistical process control (SPC) focuses on monitoring one quality characteristic at a time. Recent research on SPC has expanded its role to monitor multiple quality characteristics simultaneously. A special case in multivariate SPC is the profile analysis in which a quality characteristic is measured over time or space. Most current research tackles this problem by forming a quality characteristic vector containing all measured points in a profile. We have been working on dimension-reduction techniques to further simply the difficulty of SPC implementation. Specifically, wavelet filtering is applied to separate a profile into two distinct channels. The approximate channel contains the information on profile shape changes while the detail channel bears the information of amplitudes of a profile. We then apply a cubic B-Spline function to fit the signals from the approximate channel. Dimension reduction is then achieved by considering only a handful of control points in the B-Spline function. We have been working on applying this framework on composite manufacturing. For example, measures from various temperature sensors mounted inside an autoclave provide several similar temperature profiles over time. The proposed method would be able to provide a way to monitor production changes from batch to batch. We have also been applying profile analysis on bioinformatics applications. For example, the profile analysis approach is proposed to a cancer research that groups lipids' outputs on skin layers of experimental white mice according to the lipids' chemical properties such as LysoPC, PC, ePC, LysoPE and PE. Instead of treating each test result under a group as one independent entity, the proposed method treats all tests under one group as one profile. Variations from experimental white mice under the same treatment can be clustered together, while inter-treatment profiles can be compared according to their B-Spline functions.

Laser-based manufacturing processes

The objective in this research area is to develop laser-based manufacturing processes for various applications. Recent research includes laser-assisted machining (LAM) for difficult-to-machine materials such as ceramics (structural ceramics, bioceramics and ceramic matrix composites) and laser micromachining of various materials. Building on several years of experience in LAM of silicon nitride, we are trying to apply LAM to a new bioceramic material, which is difficult to be shaped using conventional machining processes. We are also actively working on femtosecond laser micromachining research with collaborators in academia and industry. With high-intensity, ultra-short pulses from the femtosecond laser, we are trying to develop new laser machining techniques for creating features at both micro and nano scale. We have conducted micromachining for polyurea aerogel and demonstrated high-quality cuts for this highly porous polymer. A deep microhole drilling study has also been carried out in collaboration with The Caterpillar Inc. Besides the heavy experimental nature in our research, we also attempt to gain fundamental knowledge of the processes through numerical modeling and simulation.

Publications

Publications

David Ben-Arieh

- Ben-Arieh, D., Easton, T., and Evans, B., 2009, "Minimum cost consensus with quadratic cost function," IEEE Trans. On Systems Man and Cybernetics; Part A., vol. 39, no. 1, 210-217.
- Ben-Arieh, D., and Wu, J., "Incorporating IE concepts into telemedicine," Human Factors Special Interest Group, American Telemedicine Association Conference, April 26-28 2009, Las Vegas, NV.
- Qian Li, and Ben-Arieh, D., "Joint pricing and platform configuration in product family design with genetic algorithm," Proc. of the ASME International Design Engineering Technical Conference, IDET/CIE 2009, Aug. 30- Sept. 2, 2009, San Diego, CA.

Shing Chang

- Chang, S. I., and S.H. Chou, (2009), "A study of using wavelet transformation and B-Spline approximation for nonlinear profiles monitoring," Proceedings of the 2009 Industrial Engineering Research Conference (IERC), June 2009. Miami, FL, 1567-1572.

Todd Easton

- T. Easton, "Dieting as an O.R. problem: How to minimize misery while maximizing weight loss," OR/MS Today, v. 36, n. 6, Dec., 2009, pp. 34-36.

John English

- J.R. English, L. Yu, M. Rossetti, and N. Buyurgan, "A statistical process control approach to monitoring inventory accuracy," Progress in Material Handling Research: 2008, K. Ellis, R. Meller, M.K. Ogle, B.A. Peters, G.D. Taylor, and J. Usher: Editors, pp. 128-148, 2009.

E. Stanley Lee

- Lee, E.S., Guh, Yang, and Po, "Interval-valued fuzzy relation-based clustering with its application to performance evaluation," Computers and Math. with Applications, 57, pp841-849 (2009).
- Lee, E.S., Yu-Ru, S., and Hsieh, H. T., "Fuzzy numbers in the credit rating of enterprise financial conditions," Review of Quantitative Finance and Accounting. 17, pp351-360 (2009).
- Lee, E.S., Yuan, X.-H., and Li, H.-X., "Three new cut sets of fuzzy sets and new theories of fuzzy sets," Computers Math.with Applications, 57, pp691-701 (2009).
- Lee, E.S., and Shih, S.H., "Discrete multi-level programming in a dynamic environment," in Dynamical Aspects in Fuzzy Decision Making, Yuji Yoshida, (ed.), Physica-Verlag, Berlin, Germany or Springer-Verlag, NY (2009).
- Lee, E.S., Li, and Yuan, "The three–dimensional fuzzy sets and their cut sets," Computers & Math. with Applications, 58, pp1349-1359 (2009).
- Lee, E.S., Guu, S.M., and Pang, C.T., "Asymptotic forms of fuzzy matrices," in Applied Mathematics in the Golden Age, pp 357-377, J.C. Misra, editor, a volume in the Institute of Mathematics Golden Jubilee Volume, Narosa Publishing House, New Delhi, India (2009).
- Lee, E.S., and Yuan, "Comments on 'Notes on Triple-I method of fuzzy reasoning'," Computers & Math. with Applications, 58, pp1604-1607 (2009).
- Lee, E.S., Syau, and Jia, "Generalizations of E-convex and B-vex functions," Computers and Math. with Applications, 58, pp711-716 (2009).

Shuting Lei

- Shen, X., and Lei, S., 2009, "Thermal modeling and experimental investigation for laser-assisted milling of silicon nitride ceramics," Journal of Manufacturing Science and Engineering, Vol. 131, No. 5, 051007 (10 pages).
- E. Pfefferkorn, S. Lei, Y. Jeon, and G. Haddad, 2009, "A metric for defining the energy efficiency of thermally assisted machining," International Journal of Machine Tool and Manufacture, Vol. 49, pp. 357–365.
- Lei, S., Devarajan, S., and Chang, Z., 2009, "A comparative study on the machining performance of textured cutting tools with lubrication," International Journal of Mechatronics and Manufacturing Systems, Vol. 2, No.4, pp. 401–413.
- Yang, B., Sun, J.G., Frink, E., Lei, S., and Lease, K., 2009, "Assessment of part quality in laser-assisted milling of silicon-nitride ceramic," The Proceedings of the 2009 ICALEO Congress, Laser Materials Processing Conference, pp. 489-498.
- Bian, Q., Chen, S., Chang, Z., and Lei, S., 2009, "Femtosecond laser-pulse ablation of polyurea areogel," The Proceedings of the 2009 ICALEO Congress, Laser Microprocessing Conference, pp. 924-931.
- Wu, B., Tao, S., and Lei, S., 2009, "Numerical simulation of laser beam propagation in high-aspect ratio channel," Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), West Lafayette, IN, 5p.
- Shen, X., and Lei, S., "Cutting simulation of laser-assisted milling of silicon-nitride ceramics using PFC2D," 2009, Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), West Lafayette, IN, 7p.

Z.J. Pei

- E, X.Y., Pei, Z.J., and Schmidt, K.A., "Ice cream: foam formation and stabilization— a review," accepted to appear in Food Reviews International. (2009).
- Liu, Z.P., Sun, J.G., and Pei, Z.J., "Cross-polarization confocal imaging of subsurface flaws in silicon nitride," accepted to appear in International Journal of Applied Ceramic Technology. (2009).
- Cao, J., Yuan, W.Q., Pei, Z.J., Davis, T., Cui, Y., and Beltran, M., 2009, "Feasibility study of a mechanical-biological energy manufacturing system," Journal of Manufacturing Science and Engineering, Vol. 131, No. 6, pp. 064505-1 – 064505-4.
- Shen, Y., Yuan, W.Q., Pei, Z.J., Wu, Q., and Mao, E.R., 2009, "Microalgae mass production methods," Transactions of the ASABE (an International Journal of the American Society of Agricultural and Biological Engineers), Vol. 52, No. 4, pp. 1275-1287.
- Shen, Y., Pei, Z.J., Yuan, W.Q., and Mao, E.R., 2009, "Effect of nitrogen and extraction method on algae lipid yield," International Journal of Agricultural and Biological Engineering, Vol. 2, No. 1, pp. 51-57.
- Shen, Y., Yuan, W.Q., Pei, Z.J., and Mao, E.R., 2009, "Heterotrophic culture of Chlorella protothecoides in various nitrogen sources for lipid production," Applied Biochemistry and Biotechnology, available online: http://www.springerlink.com/content/h5w3h868025u333r/.
- Qin, N., Pei, Z.J., Fisher, G.R., and Liu, J., 2009, "Simultaneous double-side grinding of silicon wafers: a review and analysis of experimental investigations," Machining Science and Technology, Vol. 13, No. 3, pp. 285-316.
- Qin, N., Pei, Z.J., Treadwell, C., and Guo, D.M., 2009, "Physics-based predictive cutting force model in ultrasonic-vibration-assisted grinding for titanium drilling," Journal of Manufacturing Science and Engineering, Vol. 131, No. 4, pp. 041011-1–041011-9.
- Wang, Q.G., Cong, W.L., Pei, Z.J., Gao, H., and Kang, R.K., 2009, "Rotary ultrasonic machining of potassium dihydrogen phosphate (KDP) crystal: an experimental investigation on surface roughness," Journal of Manufacturing Processes, doi:10.1016/j.jmapro.2009.09.001.
- Wang, Q.G., Pei, Z.J., Gao, H., Churi, N., and Kang, R.K., 2009, "Rotary ultrasonic machining of potassium dihydrogen phosphate (KDP) crystal: an experimental investigation," International Journal of Mechatronics and Manufacturing Systems, Vol. 2, No. 4, pp. 414-426.
- Churi, N.J., Pei, Z.J., Treadwell, C., and Shorter, D., 2009, "Rotary ultrasonic machining of dental ceramics," International Journal of Machining and Machinability of Materials, Vol. 6, No. 3-4, pp. 270-284.
- Cong, W.L., Zhang, P.F., and Pei, Z.J., 2009, "Experimental investigations on material removal rate and surface roughness in lapping of substrate wafers: a literature review," Key Engineering Materials, Vol. 404, pp. 23-31.
- Zeng, W.M., Xu, X.P., and Pei, Z.J., 2009, "Experimental investigation of tool wear in rotary ultrasonic machining of alumina," Key Engineering Materials, Vol. 416, pp. 181-186.
- Liu, J.H., Pei, Z.J., and Fisher, G.R., 2009, "Wheel-wear mechanisms for silicon grinding: a literature review," International Journal of Machining and Machinability of Materials, Vol. 5, No. 1, pp. 60-79.
- Pei, Z.J., Wang, D.H., and Clark, R., 2009, "Ultrasonic vibration-assisted pelleting of cellulosic biomass: a preliminary experiment," CD-ROM Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), October 4-7, 2009, West Lafayette, IN, USA.

Publications

Publications

- Cong, W.L., Zhang, P.F., and Pei, Z.J., 2009, "Experimental investigations on flatness and subsurface damage in lapping of substrate wafers: a literature review," CD-ROM Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), October 4-7, 2009, West Lafayette, IN, USA.
- Wu, J.Q., Cong, W.L., Williams, R.E., and Pei, Z.J., 2009, "Stochastic modeling and analysis of rotary ultrasonic machining," CD-ROM Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), October 4-7, 2009, West Lafayette, IN, USA.
- Qin, N., Pei, Z.J., and Guo, D.M., 2009, "Ultrasonic vibration-assisted grinding of titanium: cutting-force modeling with design of experiments," CD-ROM Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), October 4-7, 2009, West Lafayette, IN, USA.
- Qin, N., Pei, Z.J., and Guo, D.M., 2009, "Nanotopography in silicon wafer manufacturing: a literature review," CD-ROM Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), October 4-7, 2009, West Lafayette, IN, USA.
- Zhang, P.F., and Pei, Z.J., 2009, "An experimental investigation on subsurface damage in lapping of lithium niobate wafers," CD-ROM Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), October 4-7, 2009, West Lafayette, IN, USA.
- Yuan, W.Q., Y. Cui, and Pei, Z.J., 2009, "Algal cell-surface interaction: an overview and preliminary test," CD-ROM Proceedings of the 2009 International Manufacturing Science & Engineering Conference (MSEC), October 4-7, 2009, West Lafayette, IN, USA.
- Cong W.L., Pei, Z.J., Van Vleet, E., and Wang, Q.G., 2009, "Surface roughness in rotary ultrasonic machining of stainless steels," Proceedings of the IIE Annual Conference and Expo 2009 – Innovations Revealed, Miami, FL, May 30 – June 3, 2009.
- Cong W.L., Pei, Z.J., Churi, N., and Wang, Q.G., 2009, "Rotary ultrasonic machining of stainless steel: design of experiments," Transactions of the North American Manufacturing Research Institution of SME, Vol. 37, pp. 261–268.
- Sun, J.G., Liu, Z.P., Pei, Z.J., Phillips, N.S.L., and Jensen, J.A., 2009, "Optical methods for nondestructive evaluation of subsurface flaws in silicon nitride ceramics," Ceramic Engineering and Science Proceedings, Vol. 29, No. 3, pp. 181-188, 2009, Corrosion, Wear, Fatigue, and Reliability of Ceramics - A Collection of Papers Presented at the 32nd International Conference on Advanced Ceramics and Composites.
- Yuan, W.Q., Pei, Z.J., and Cui, Y., 2009, "Exploratory research on algae ocean farming for biofuel production," ASABE paper number 096433, ASABE, St. Joseph, MI.
- Shen, Y., Yuan, W.Q., Pei, Z.J., and Mao, E.R., 2009, "Optimizing the wet-milling process for lipid extraction of microalgae Scendesmus dimorphus," ASABE paper number 096005, ASABE, St. Joseph, MI.
- Shen, Y., Anderson, M., Ty, M., Pei, Z.J., and Yuan, W.Q., 2009, "Growing algae in photobioreactors for lipid production," Mid-Central Conference of ASABE, paper number MC09-506, Ames, IA.
- Zhang, P.F., Li, Z.C., Cong, W.L., and Pei, Z.J., 2009, "Fundamental research on silicon wafer fine grinding: 2008 progress report," CD-ROM Proceedings of 2009 NSF Civil, Mechanical and Manufacturing Innovation Grantees and Research Conference; Honolulu, Hawaii, June 22-25.
- Liu, Z.P., Sun, J.G., and Pei, Z.J., 2009, "Cross-polarization confocal imaging of subsurface flaws," CD-ROM Proceedings of 2009 NSF Civil, Mechanical and Manufacturing Innovation Grantees and Research Conference; Honolulu, Hawaii, June 22-25.
- Pei, Z.J. (editor), 2009, "Tips on getting an academic position," Lulu, Inc. (ISBN 978-0-557-05363-6).
- Yuan, W.Q., Cui, Y., and Pei, Z.J., 2009, "Immobilized algae culture for biofuel manufacturing: an overview and progress report," CD-ROM Proceedings of 2009 NSF Civil, Mechanical and Manufacturing Innovation Grantees and Research Conference; Honolulu, Hawaii, June 22-25.

Malgorzata Rys

- Rys, Malgorzata J. and Jacob, Romal S. "Pilot car wait-time notification system," Journal of Transportation Engineering, Vol. 135, No. 11, Nov. 2009.
- Rys, Malgorzata J., Shah, Harshit D. and Russell, Eugene "Study of driver's behavior at passive railroad-highway grade crossings," Journal of Transportation Research Forum, Vol. 48, No. 2, pp. 39-50, 2009.
- Karkle, D., Makarla, R., Rys, M.J. and Russell, E. "Centerline rumble strips: a study of exterior noise," Proceedings from the 14th Annual International Conference on Industrial Engineering Theory, Applications and Practice, ISBN: 978-0-9652558-5-1, Anaheim, CA, Oct. 2009.
- Joshi, Amita and Rys, Malgorzata "Study on the effect of different arrival patterns on an emergency department's capacity using discrete event simulation," Proceedings from the 14th Annual International Conference on Industrial Engineering Theory, Applications and Practice, ISBN: 978-0-9652558-5-1, Anaheim, CA, Oct. 2009.
- Karkle, D., Rys, M. and Russell, E. "Evaluation of centerline rumble strips for prevention of highway crossover accidents in Kansas," Proceedings of the 2009 Mid-Continent Transportation Research Symposium, Ames, IA, Aug. 2009.

Chih-Hang Wu

- Wu, C.-H., Zhao, W., Beck, T., and Peterman, R. "Optical sensor developments for measuring the surface strains in prestressed concrete members," Journal of Strains, Online Publishing and printed publishing will follow. 2009.

GRANTS

Grants

David Ben-Arieh

- "Measuring and Analyzing Efficiency of Safety-Net Clinics," submitted to the Center for Engagement and Community Development, $18,500 (with Dr. Wu), starting Jan. 2009 for one calendar year.
- "Improving Patient Flow in the ED," $6000 from University of Kansas Medical School.

Kimberly Douglas-Mankin

- Douglas-Mankin, Kimberly D., Hanson, Brian R. (Kansas Industrial Extension Services), and Snead, Bruce C. (Kansas Industrial Extension Services), US Environmental Protection Agency, "Operational Process for EPA Radiation and Indoor Environments: Laboratory Environmental Professional Student Intern Program."

Todd Easton

- Co-PI, (Caterina Scoglio and Walter Schumm), National Science Foundation, "SGER: Exploratory Research on Complex Network Approach to Epidemic Spreading in Rural Regions," $50,001, Sept. 2008- Aug. 2009.

R. Michael Harnett

- Harnett, R. Michael, US Department of Defense, $23,678, "Part-Time M.S. Program in Industrial Engineering - Summer 2009."
- Harnett, R. Michael, US Department of Defense, $49,296, "Part-Time M.S. Program in Industrial Engineering - Fall 2008."
- Harnett, R. Michael, US Department of Defense, $41,652, "Part-Time M.S. Program in Industrial Engineering - Spring 2008."
- Harnett, R. Michael, US Department of Defense, $51,588, "Part-Time M.S. Program in Industrial Engineering - Spring 2009."

Bradley Kramer

- PI, Kansas Technology Enterprise Corporation, "Kansas Technology Enterprise Corporation Center of Excellence Grant Agreement," $645,000, July 2009 - June 2010.
- PI, U.S. Department of Commerce, "Early-Stage Technology Development Assistance Center: Bridging the Gap Between New Technologies and Commercialization," $170,000, Aug. 2007 - July 2010.
- PI, Kansas Department of Commerce, "Develop and Implement Early-Stage Technology Development Assistance Center," $45,000, Aug. 2007 - July 2010.
- PI, Kansas Technology Enterprise Corporation, "EDA Early-Stage Technology Development Assistance Center: Phase II," $50,000, July 2007 - June 2010.
- PI, Kansas Environmental Management Associates, LLC, "Phase IV & V: Farm-Scale, Phosphorus-Recovery Master Agreement Construction, Start-Up and Monitoring (P08-0102)," $120,984, Jan. 2007 – Jan. 2011.

Shuting Lei

- Co-PI, (with Zenghu Chang and C. Lewis Cocke), DOD, "Attosecond Optical Technology Based on Recollision and Gating," $1,250,000, May 2009- April 2010.
- PI, (with Zenghu Chang), National Science Foundation, "Collaborative Research: Mathematical Modeling and Experimental Study of Femotosecond Laser Machining of High-Aspect-Ratio Microstructures," REU supplement, $6,000, June 2009- May 2010.

Zhijian Pei

- Pei, Zhijian, Crystal Technology, Inc., $32,500, "Development of Advance Fabrication Process of Lithium Niobate."
- Pei, Zhijian, Crystal Technology, Inc., $20,000, "Development of Advance Fabrication Process of Lithium Niobate - Patrick Zhang (Internship)."
- Pei, Zhijian, National Science Foundation, $277,363, "Collaborative Research: Fundamental Research on Titanium Drilling with Rotary Ultrasonic Machining."
- Pei, Zhijian, National Science Foundation, $225,782, "Funding for Student Participation in the 2009 CMMI Grantees Conference."
- Pei, Zhijian, and Yuan, Wenqiao (Biological and Agricultural Engineering), National Science Foundation, $11,000, "SGER: Exploratory Research on Solid Carriers for Manufacturing Algae Biofuels in the Ocean."
- Pei, Zhijian, National Science Foundation, $20,411, "Workshop/ Collaborative Research: 2010 NSF CAREER Proposal Writing."
- Pei, Zhijian, National Science Foundation, $22,958, "Workshop: 2009 NSF CAREER Proposal Writing Workshop."

Malgorzata Rys

- "Keeping Vehicles on the Roadway in Rural Areas: Analysis of Run-off-the-Road Crashes," S. Dissanayake, E. Russell, M. Rys, and R. Stokes, University Transportation Center, Kansas State University, Nov. 2009 – May 2011, ($119,972).
- "Study of KDOT Policy on Lane and Shoulder Minimum Width for Application of CLRS," M. Rys and E. Russell, Kansas Department of Transportation, July 1, 2009 – Dec. 31, 2010, ($59,000).
- "Evaluation of the External Noise Produced by CLRS," M. Rys, Jan. 1, 2009 – Dec.31, 2009, University Transportation Center, Kansas State University, ($6,500).
- "Promoting Center-Line Rumble Strips to Increase Rural, Two-lane Highway Safety," M. Rys and E. Russell, Kansas Department of Transportation and University Transportation Center, July 1, 2007 – Dec. 2009, ($79,000).

Chih-Hang Wu

- Wu, Chih-Hang, Beck, B. Terry (Mechanical and Nuclear Engineering), and Peterman, Robert J. (Civil Engineering), Kansas Department of Transportation, $7,022, "Implementation of Non-Contact Strain Measurement Device for Bridges and Piers."

General inquiries

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Professional Leadership

David Ben-Arieh
- IFIP Work Group 5.1 (Information Technology in the Product Realization Process)
- SHS (Society of Health Systems) Book of Knowledge Committee

Shing Chang
- Editorial committee, International Journal of Information and Decision Sciences (IJIDS)
- Editorial committee, International Journal of Experimental Design and Process Optimisation (IJEDPO)

John English
- Juror, National Council for Engineering Examinations and Surveyors
- Member, Board of Directors, Reliability and Maintainability Symposium
- Member, Board of Directors, NISTAC
- Member, IIE Honors and Awards Committee
- Member, Board of Directors, Kansas Foundation for Engineers

E. Stanley Lee
- Editor, associate editor, or on the editorial board of the following journals:
  - International Journal of Artificial Life Research, IGI-Global
  - International Journal of Operations Research
  - International Journal of Modeling and Simulation, ACTA press, Calgary, Canada
  - Fuzzy Optimization and Decision Making, Kluwer Academic Publishers
  - Mathematical Sciences Research Hot-Line
  - Computer and Mathematics with Applica-tions
  - Indian Journal of Management and Systems
  - Journal of Engineering Chemistry and Metallur-gy
  - Journal of Nonlinear Differential Equations: Theory, Methods, and Applications
  - Journal of the Chinese Institute of Industrial Engineers
  - International Journal of Fuzzy Systems
  - The Chinese Journal of Process Engineering
  - Journal of Uncertain Systems (JUS)
  - Scholarly Research Exchange
  - International Journal of Artificial Life Research
- Honorary Professor, Chinese Academy of Sciences, People's Republic of China
- Organizer, Bellman Continuum Workshops and Conference
- Panelist and reviewer, National Research Council

Shuting Lei
- Editorial board member, International Journal of Mechatronics and Manufacturing Systems

Bradley Kramer
- Vice chair, The IDEA Center Board of Directors

Zhijian Pei
- SME NAMRI Scientific Committee
- Vice chair, ASME MED Manufacturing Processes Technical Committee
- Organizer, 2009 NSF CAREER Proposal Writing Workshop, George Mason University
- Chair, MSEC 2009 session 2-1: Biomass and Bioenergy, Purdue University
- Assoc. technical editor, Machining Science and Technology
- Assoc. editor, Journal of Manufacturing Processes
- Editorial board member, International Journal of Engineering Business Management
- Editorial board member, International Journal of Machine Tools and Manufacture
- Editorial board member, International Journal of Machining and Machinability of Materials
- Editorial board member, International Journal of Nanomanufacturing
- Editorial board member, Journal of Machining and Forming Technologies
- Editorial board member, Open Mechanical Engineering Journal
- Editorial board member, Recent Patents on Mechanical Engineering

Malgorzata Rys
- Member, Institute of Industrial Engineering
- Member, Human Factors and Ergonomics Society
- Editorial board member, International Journal of Practice
- Chair, Annual International Conference on Industrial Engineering—Theory Applications and Practice
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Undergraduate Studies

Undergraduate

Undergraduate

Undergraduate enrollment has continued to grow during the past few years. IMSE had a total enrollment of more than 160 undergraduate students; approximately 30 percent of those students are females. On the average, our students have more than two engineering intern positions prior to graduation. During the spring and fall 2009 commencement ceremonies, 20 BSIE degrees were granted. Graduates of our program are in strong demand in Kansas, the Midwest region and across the nation. Companies that recruited our graduates last year include Accenture, Altec Industries, Inc., Burlington Northern-Santa Fe Railway, Caterpillar, Cessna, Exxon Mobile, Halliburton, Honeywell, Hormel Food and J.B. Hunt. Average annual starting salary for our graduates was $60,000.

The IMSE department recently created a concurrent B.S./M.S. degree program that allows top students to begin to work on a Master of Science degree while they are still undergraduate students. Starting salaries for graduates of the program have been approximately $75,000, which is $15K more than the starting salary offers for the B.S. graduates. Students in the program earn a broader and deeper appreciation for industrial engineering through advanced-level coursework. They also significantly enhance their technical skill set through active engagement in research.

IMSE students and faculty are working together to improve health care systems. Our goal is to increase the quality of health care while simultaneously reducing costs. To do so, IMSE students work with IMSE faculty on projects sponsored by hospitals, clinics and other health organizations. Last year, 12 IMSE undergraduate students worked on projects emphasizing process improvement, facility layout and safety with multiple hospitals in Omaha, Kansas City and Hayes. To accomplish these projects, the students used IMSE tools such as process modeling, simulation, quality engineering, and the design and implementation of modern information systems.

Awards

In 2009, one of our students received the Material Handling Education Foundation Scholarship. Since its inception in 1976, 29 K-State IMSE students have been awarded this scholarship. Over that same time period, approximately 650 students received that award. That means 4.5 percent of all awards given nationally were received by students from our department.

IIE Student Chapter

The department has an active student chapter of the Institute of Industrial Engineers; advisor, Dr. Margaret J. Rys. The IIE officers organized a number of activities promoting academic and social interaction between the members. The chapter hosted student/faculty picnics, mentor day, a financial workshop, and a tailgate party with the University of Oklahoma IIE student chapter and the Kansas City IIE senior chapter; sponsored displays at K-State Open House; and participated in the Technical Paper Conference. The chapter received the Gold Award in the 2009 IIE national chapter recognition competition.

Graduate Studies

Graduate

Graduate program

The industrial and manufacturing systems engineering department is committed to excellence in scholarly research and graduate teaching. We offer a rich variety of projects in the areas of operations research, ergonomics, manufacturing and office systems, uncertainty representation and intelligent reasoning, as well as quality engineering. In addition to basic research, our curriculum emphasizes collaborative and interdisciplinary research, collaboration with industrial partners, and development and modeling of various industrial processes.

We offer four graduate degrees: the Master of Science in industrial engineering (MSIE), the Master of Science in operations research (MSOR), the Master of Engineering Management (MEM) and a Doctor of Philosophy in industrial engineering. The master's degrees in operations research and in engineering management are available via distance learning to better serve our students.

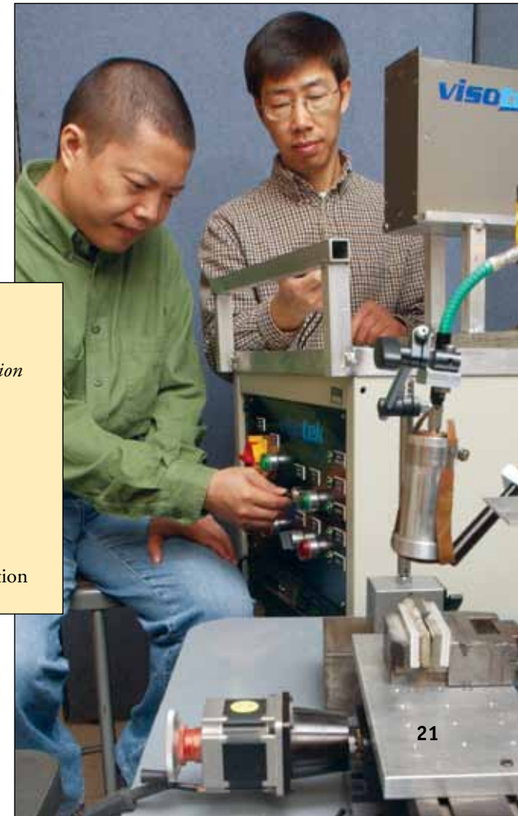
The MSIE program teaches students the mathematical, scientific and analysis skills to solve complex business problems in manufacturing, health care, transportation, financial organizations, communications, government, military and many other organizations. The MSOR program focuses on the application of mathematical models to analyze complex problems and develop optimum solutions. The MEM program is geared toward the management of engineering or highly technical organizations as well as money, people and equipment.

Admission requirements

Applicants for our graduate degrees must possess a bachelor's degree in engineering with at least a 3.0 grade point average or equivalent from accredited institutions. Students not possessing a degree in engineering must have a background that includes the equivalent of core undergraduate engineering and mathematics courses. In addition to requiring all our international applicants to submit GRE scores and have an Internet-based TOEFL of 79, we also require GRE scores for all of our graduate degree applicants, except Internet applicants whose working addresses are located within the USA.

Areas of concentration

The IMSE department has expertise in discrete systems, continuous systems, stochastic systems, linear and nonlinear programming, quality and control of quality, decision making, ergonomics, manufacturing processes design and improvement, efficiency of manufacturing and office systems, engineering management, fuzzy sets, neural networks and intelligent systems.



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Application materials

- Online application: *www.k-state.edu/grad/application*
- Confirmation sheet
- Application fee
- Official transcripts
- TOEFL and GRE scores
- Affidavit of financial support
- Statement of objectives
- Three letters of recommendation

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