In Gear

Looking Toward the Future

The Edward P. Fitts Department of Industrial and Systems Engineering seeks to lead the profession by providing tomorrow’s leaders. That’s why we’re continuously adding to the breadth of our program through endowed professorships, doctoral fellowships, international programs, interdisciplinary collaboration and innovative scholarship. Not only are we developing revolutionary ideas in traditional areas, we are pioneering breakthroughs in new ones. We hope you’ll continue to read on to learn how we are affecting change for the country and the world.

RICHARD BERNHARD AND STEPHEN ROBERTS ELECTED FELLOWS OF IIE

This spring, Professors Richard H. Bernhard and Stephen D. Roberts were elected Fellows of the Institute of Industrial Engineers, joining 15 of their colleagues at NC State.

Professor Bernhard has served with distinction on the faculty of the Department of Industrial Engineering and Operations Research at Cornell University (1961-1969) and on the faculty of the Department of IE at NC State (1969-present). He has published a series of articles on the theoretical foundations of economic analysis for capital investments that are widely recognized as landmarks in the literature. In addition to making major contributions to the basic theory of industrial engineering in the areas of engineering economic analysis and mathematical programming, Professor Bernhard has made pioneering applications of that theory to such diverse problems as environmental emissions control, municipal garbage-truck replacement, and university examination scheduling.

In all his professional activities, Professor Bernhard has served as a highly effective ambassador for the field of IE, thereby advancing the status and prestige of the discipline. In 1995, he received the Wellington Award from the Engineering Economy Division of the Institute of Industrial Engineers (IIE) for his outstanding technical contributions and service to the field of engineering economic analysis and to the larger field of industrial engineering. He has served on the selection committee for the Wellington Award since 2005, and this year is the chair of the committee.

Professor Roberts has served with distinction on the faculties of the Department of Industrial and Systems Engineering at the University of Florida (1968-1972); the School of Industrial Engineering at Purdue University (1972-1990); the Department of Internal Medicine at Indiana University (1972-1990); and the Edward P. Fitts Department of ISE at NC State (1990-present). Professor Roberts’s research interests are focused primarily in the areas of simulation modeling methodology (for which he is widely recognized as one of the world’s foremost authorities) and its applications to medical decision-making. Much of Professor Roberts’ research effort over the past three decades has been devoted to the development of process-interaction and object-oriented simulation languages such as INSIGHT and YANSL, and these languages are among the most powerful and elegant of their type.

Over the past four decades, Professor Roberts has also published a series of articles on medical decision-making that are widely recognized as seminal contributions to the literature and his most recent work has focused on colorectal cancer and the use of simulation models to develop improved screening methods for early detection of this disease. In May 2004, Dan Cubbage completed his master’s thesis titled, “Simulation of Colorectal Cancer: The Natural History of the Disease” under Professor Roberts’ supervision; and in May 2005, Dan received the Graduate Research Award (Second Place) from IIE for this work. In December 2004, Ali Tafazzoli Yazdi completed his master’s thesis titled, “A Comparison of Screening Methods for Colorectal Cancer” under Professor Roberts’ supervision; and in May 2006, Ali received IIE Graduate Research Award (Second Place).

News Nuggets:

Welcome Aboard

The department is pleased to announce that Distinguished Alumnus Tim Scronce is the newest member of our ISE Advisory Board. Tim is president and CEO of Telworx Communications, a distributor to the wireless, wireline and government telecommunications sectors. Prior to acquiring Telworx in 2005, he was president and COO of Blue Rhino Corporation, the leading propane tank exchange company in America. In addition, Tim held executive level positions at Diageo as well as management positions with Continental Baking Company and Frito-Lay. Tim received his B.S.I.E. degree from NC State in 1987 and recently completed an MBA from the University of Phoenix. Tim currently serves as a director of the NC State Engineering Foundation and he and his wife, Sandra, have endowed a scholarship in the College of Textiles in honor of Tim’s father.

IIE Conference Spotlight Sessions

The department hosted a morning breakfast reception at the IIE Annual Conference and Expo 2008 (held in Vancouver) to help celebrate the field of ISE and showcase the unique approach we’re taking at NC State. We also held a panel session on “The Role of Academic Advisory Boards In the Success of IE Programs” that explored the inner workings of advisory boards via discussions with some of our field’s most forward thinkers.
**YUAN-SHIN LEE ELECTED FELLOW OF ASME**

Professor Yuan-Shin Lee was recently elected Fellow of the American Society of Mechanical Engineers. He has served on the faculty at NC State since 1995, and quickly established an international reputation as one of the pioneers in the field of computational manufacturing – particularly in the areas of sculptured surface manufacturing, machined surface error analysis, three-dimensional shape-generation processes, and tool-interference avoidance. By effectively combining the methods of classical manufacturing engineering, differential and computational geometry, computer graphics, and optimization, Professor Lee has developed a comprehensive methodology for the solution of a wide range of closely interrelated problems that arise in multi-axis sculptured surface machining. This work constitutes a major advance in both the practice and theory of numerically controlled sculptured surface manufacturing; moreover, Professor Lee has made important contributions to such diverse fields as applied computational geometry, bioinformatics, and manufacturing engineering for biotechnology industries.

Professor Lee’s leadership in research activities is exemplified by his work on the problem of collision-free curvature matched machining of sculptured surfaces. Exploiting his expertise in computational and differential geometry as well as computer graphics and heuristic optimization, Professor Lee has developed effective algorithms for optimal tool selection, routing (path planning), and attitude control (motion planning) of tools of general shapes in order to minimize machining time and maximize product quality while avoiding collisions or gouging. These developments have been critical to the effective use of multi-axis numerically controlled (NC) machines in rapid tooling as well as in the manufacture of a wide range of complex parts, including aerospace parts, automotive parts, turbine blades, marine propellers, dies, and molds. His most recent work has been in the design and development of a computational engine for computer-aided molecular design, including a five-degree-of-freedom haptic device for molecular docking and molecular assembly.

**ISE ASSISTS IN SPACE EXPLORATION**

As previously reported in *ingear*, Dr. Denis Cormier’s research focuses on the fabrication of advanced materials and structures primarily for the aerospace industry. Much of his work is being done using the Electron Beam Melting (EBM) process in which solid metal parts in virtually any geometric shape can be fabricated without molds or dies. Perhaps the most interesting aspect of this work involves collaboration with NASA in which his team is attempting to fabricate components using lunar regolith simulants (aka “moon dust”). The aim of that project is to see if future astronauts living in habitats on the Moon and Mars can fabricate replacement parts using the available raw materials.

**ISE DEVELOPS MICRONEEDLES FOR DRUG DELIVERY**

Dr. Yuan-Shin Lee, Professor of ISE at NC State, has developed an innovative 2PP (two photon polymerization) process to produce three-dimensional microstructured medical devices using Ormocer®, an organic-inorganic hybrid material currently used in dentistry. The cutting-edge 2PP process is a novel technique for processing hybrid organic-inorganic materials for biomedical and biomanufacturing applications. Dr. Lee, in collaboration with Dr. Roger Narayan, Associate Professor of Biomedical Engineering at University of North Carolina-Chapel Hill, developed a comprehensive modeling, simulation and processing system to fully and systematically assess the structural and functional properties of Ormocer® microneedles for delivery of levodopa in Parkinson’s disease patients. The process opens new possibilities for micro and nano devices that are customized for specific biomedical purposes. The results of this research provide a new technical breakthrough for the development of novel laser processes for creating advanced bioceramics. The outcome of this project also provides a significant advancement of the next generation microstructure biomaterials design and modeling.
OPTIMIZING DISEASE TREATMENT DECISIONS FOR PATIENTS WITH TYPE 2 DIABETES

According to the American Diabetes Association, there are more than 20 million children and adults in the United States who have diabetes. Of the affected population, approximately 90 percent have type 2 diabetes. Currently, several risk models exist to predict the probability of complications related to type 2 diabetes; however, there has been limited investigation of how to use these models to make optimal treatment decisions. NC State ISE Professor Brian Denton is investigating ways to bridge this gap by furthering the basic understanding of optimal treatment decisions over the course of a patient’s lifetime. Through a multidisciplinary collaboration, including investigators at NC State and Mayo Clinic in Rochester, MN, he has developed new mathematical models and new solution methodologies to study optimal treatment plans to lower the incidence of stroke and heart attacks in patients with type 2 diabetes, and to trade-off this benefit with the side effects of medication, and the total cost of treatment.

Furthering the understanding of optimal treatment options will ultimately improve the quality of life for a large and growing proportion of the population, and substantially reduce the total cost burden on the healthcare system, freeing resources for other uses. Denton anticipates the results of the study will also provide insights into the treatment of cardiovascular disease, the most common cause of death in the U.S. for the general population.

CUSTOM DESIGN AND DIRECT FABRICATION OF TITANIUM PALATE IMPLANT

Pez is a beagle that arrived at the Vet School with a hole in his palate, which caused difficulties when he was feeding. Some of the food entered the nasal cavity causing respiratory problems, sneezing and grunting. Three surgeons at NC State’s College of Veterinary Medicine teamed up with ISE’s Ola Harrysson and graduate student Omer Cansizoglu to help. A Computed Tomography (CT) scan was acquired of Pez’s skull and the images were transferred to ISE’s Medical Modeling Research Group. The images were converted into a 3D computer model and a Fused Deposition Modeling (FDM) machine was used to fabricate a plastic replica of Pez’s skull for evaluation of the palate deformity. Based on the model, it was determined that some of the teeth had to be removed to make space for the planned implant. After the dental work was completed, a new CT scan was acquired and a new 3D computer model of Pez’s mouth was created. A haptic device and specialized software were used to design a custom implant to cover the hole in Pez’s palate. A haptic device gives tactile feedback to the user and the Virtual Clay provides a realistic environment for the designer. The designer is sculpting a virtual implant while “feeling” the model of the skull. The design of the implant was presented to the surgeons and design revisions were conducted in several steps. Once the design had been approved by all surgeons, a stereolithography machine (SLA) was used to fabricate an accurate prototype of the implant and the skull. Upon design and fit approval, the implant was fabricated using an Electron Beam Melting (EBM) machine. In this case, titanium powder was used and a solid titanium implant was fabricated. A couple of days prior to the surgery, the entire procedure was rehearsed using the titanium implant and the SLA replica of Pez’s skull. The rehearsal went smoothly and the surgery was scheduled a few days later. During the surgery, the plastic models served as guides to the surgeons and the procedure was completed in a shorter time than expected. The implant fit perfectly and Pez is currently doing great. The soft tissue has healed much faster than expected and Pez can eat again without filling up his nasal cavity with food. The ability to design and fabricate specialized medical devices will be critical for human health in the future and ISE is paving the way with novel approaches to design and fabrication.
MEASURING AND MODELING “CLUTTER” IN COCKPIT DISPLAYS FOR IMPROVED DESIGN AND FLIGHT SAFETY

NASA is currently designing the next generation of commercial aircraft cockpit displays that integrate conventional flight display symbology with infrared radar imagery for night vision of terrain. NC State ISE Professor David Kaber is assisting NASA in assessing pilot perceptions of visual “clutter” in these new head-up displays and in relating clutter to flight performance. Clutter is an unintended effect of displaying visual imagery that may obscure or confuse other information or that may not be relevant to the task at hand. He conducted an experiment with expert B-757 pilots and found that even though new display features may provide useful flight information, if the visual density exceeds the information density relative to flight tasks, pilots consider displays to be “cluttered” and may not use them. Kaber is currently working on two more experiments that will make use of the Integration Flight Deck (IFD) Simulator at NASA Langley (an exact copy of a B-757 cockpit) to identify visual display properties (e.g., contrast ratio, occlusion) influencing perceived clutter and to determine how much clutter is just too much. He is looking for ("knee") points in pilot simulator performance when display information increases without an improvement in flight control or, worse yet, when errors occur. It is NASA’s hope that these measures will be used by avionics manufacturers in design and engineering future cockpit displays.

FIRST ANNUAL HEALTHCARE ENGINEERING SYMPOSIUM HELD

The First Annual Healthcare Engineering Symposium on “The Interface of Health Services Research and Healthcare Engineering” was held April 6-8 in Research Triangle Park, NC. The symposium was initiated by the Healthcare Engineering Alliance (HEA) and locally organized by the Edward P. Fitts Dept. of ISE at NC State; the Dept. of ISE at NC A&T State University; and the Cecil G. Sheps Center for Health Services Research at UNC-Chapel Hill, with financial support from the National Science Foundation. With an international attendance of over 175, the objective was to bring together recognized experts from healthcare engineering and health systems to educate each other as to their work and potential for collaboration, and to discuss actionable mechanisms for collaboration between the two fields to help move their findings into clinical practice and health policy.

Professors Stephen Roberts and Reha Uzsoy served as symposium co-chairs. The opening session featured views from the healthcare engineering perspective (Dr. Dale Compton, Purdue University) and health services perspective (Dr. Eugene Oddone, Department of Veterans Administration) as well as national perspectives from the Veterans Administration, National Science Foundation and Agency for Healthcare Research and Quality (AHRQ). Subsequent sessions featured speakers addressing key issues impacting healthcare engineering, including: Effectiveness of Healthcare Delivery, Promoting Access, and Improving Operations. Dr. Vinod Sahney of Blue Cross-Blue Shield of Massachusetts provided a stimulating dinner talk, Challenges: How to Move Forward? The symposium provided a forum for a diverse set of researchers and care providers to dialogue on how to provide improved healthcare while controlling costs.

IE GRADS GET LinkedIn

Whether you graduated in ‘62, ‘92, ‘02 or some other fine year, we’d love to get reconnected with you. Please consider joining the NC State College of Engineering group on LinkedIn, the professional networking site. LinkedIn is a way to network, ask questions, reconnect with classmates, and help other alumni.

By joining our group and reaching out to other NC State engineers, you will be strengthening our alumni network, which helps us all succeed. To join, please send an email to David Mainella at david_mainella@ncsu.edu or call 919.515.9957. ISE alumni can also contact Assistant Head Clarence Smith at csmith@eos.ncsu.edu or 919.515.6416 to get connected.

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