Department of Mechanical Engineering

Summer 2006

Linkages

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Engineering by Design

Students spend years developing the expertise they will need to become successful engineers, but some essential skills are difficult to learn in a lecture or from a textbook. Today's careers in engineering demand skills in design, creativity, communication and leadership, as well as rigorous preparation in math and science. In the Senior Design Projects course, the Mechanical Engineering department at UConn is able to offer students the kinds of hands-on experience in engineering which can best prepare them to excel.

The course matches engineering problems from industries to student teams who are asked to create a solution for specified overall needs. Professor Tom Barber, who has taught Senior Design in the department for six years, describes the course as "the culmination of three to four years of education—calling on the resources of those years, and also introducing new techniques, tools and approaches that students have never seen before." In the two-semester format of the course, students brainstorm and develop a suite of designs, systematically down select, develop and improve a design, build a product (or a model), and deliver their findings through prototypes, reports and presentations. The course also includes lectures on topics of personal and professional development such as engineering ethics, intellectual property law and graduate study. Professor Barber notes that this kind of in-depth experience sets the course apart: "In almost every other course, students are given assignments in which they fill in a box and check the answer which may be available at the back of the textbook. Here, the questions are open-ended; there is never one correct answer."

The results of the students' ambitious work can be seen at the culminating event of the course, Senior Design Presentation Day, in which students present their projects to members of industry, faculty, and visitors from within and outside of the University community. A wide array of engineering fields are involved: this year, projects included work on jet exhaust, space suits, elevator rails, massage chairs, printing presses, and pharmaceuticals, to name just a few. Chrisanne Mortensen, a team mentor for the Unilever company on campus for the event, commented that her company was pleased to not only receive a viable solution to the problem they sponsored, but also to have recruited a strong UConn student. She spoke enthusiastically about the Senior Design program, saying that Unilever has enjoyed a "long term commitment to engineering education, and a very good partnership with UConn" and that the student team Unilever sponsored was "great: responsive, prepared and thorough."

Continued on page 3

University of Connecticut

In This Issue

FROM THE DEPARTMENT HEAD

Dear Alumni and Friends,

We rounded up another successful academic year marked by significant achievements in undergraduate and graduate education, faculty honors and scholarship, industrial and alumni relations, and outreach. I am delighted to highlight some of these here.

The department's activities in support of our educational mission are strengthened through strategic industrial alliances. The department's senior design projects course continues to grow stronger each year and has emerged as a successful model of how industries can intimately partner with universities in training the future generation of engineers. This past year featured 25 different projects—a two-and-a-half-fold increase from just three years ago! You can read more about our senior design program in this issue.

I mentioned in the Winter 2006 **Linkages** issue that the department was the beneficiary of a generous donation from National Instruments including hardware, a department-wide site license of LabVIEW software, full training of personnel, and technical support. Recently, the department also received an in-kind donation from Fluent, Inc., for unrestricted use in our educational and research endeavors. The donations not only enrich our existing courses but also enable us to plan new course offerings utilizing these tools. The department's teaching and computational laboratories were upgraded in spring 2006 with new equipment, expanded experimental stations, a new line of experiments, and computers and software. A Mechanical Engineering Honors Research program was initiated to closely engage Honors students in the department in the ongoing research programs, and to provide them with experience in independent problem solving. We believe that this will significantly augment the classroom experience that the students traditionally receive as part of their curriculum.

Paralleling our educational excellence is the growth in the research productivity and scholarship of the department's faculty, graduate students, and research staff. Many new research programs were funded by federal grants during the year. The newsletter profiles three of our faculty members and a sampling of their research programs. An annual graduate research competition debuted this spring in which twelve doctoral students presented their research and vied for three top prizes. Benchmarking against the Mechanical Engineering graduate programs of the public universities in the Northeast and the Mid-Atlantic states, the department's graduate program ranked #7 in the 2007 *U.S. News & World Report* rankings. Our goal is to continue to grow our graduate program relative to this peer group of institutions.

During the past year, the department's faculty authored 3 fundamental textbooks in the field of thermal and fluid sciences, published 59 refereed journal articles and 13 book chapters, and contributed 74 conference publications or presentations. The impact of the department's research contributions over the years is evident in the peer-citations of the faculty-authored publications. In 2005, the publications were cited an average of 38.2 per faculty member (Source: Web of Science)—double the citation average from 2000 and a 19-fold increase over the last decade.

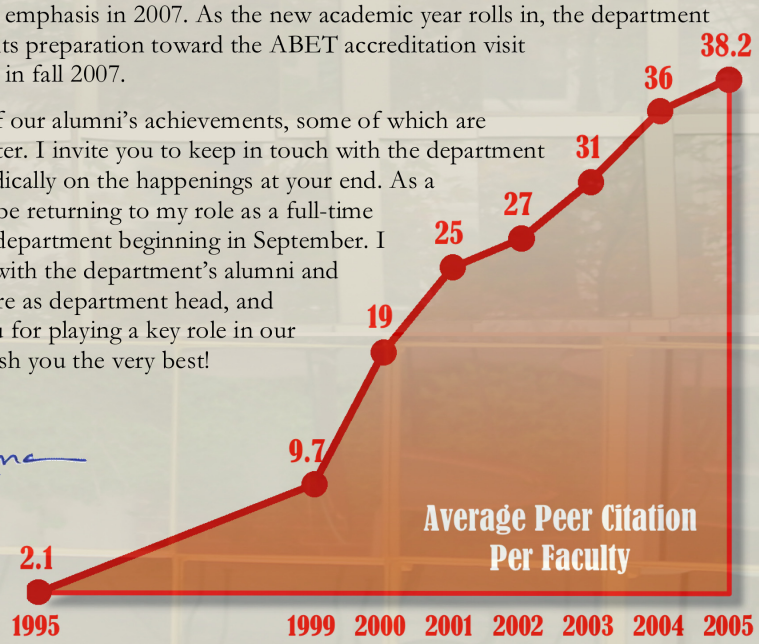
Our faculty base continues to grow with a search underway to fill two new positions with a biomedical engineering emphasis in 2007. As the new academic year rolls in, the department will also be gearing up its preparation toward the ABET accreditation visit scheduled to take place in fall 2007.

We are always proud of our alumni's achievements, some of which are profiled in this newsletter. I invite you to keep in touch with the department and to update us periodically on the happenings at your end. As a personal update, I will be returning to my role as a full-time faculty member in the department beginning in September. I have enjoyed working with the department's alumni and friends during my tenure as department head, and would like to thank you for playing a key role in our continued success. I wish you the very best!

Sincerely,

Ranga Pitchumani

Ranga Pitchumani
Distinguished Professor and Department Head



Linkages is published for the alumni, faculty, students, corporate supporters and friends of the Department of Mechanical Engineering at the University of Connecticut. Suggestions and information are welcome. Send correspondence, alumni updates and address corrections to **Linkages** at the address below or email **ejerome@engr.uconn.edu**.

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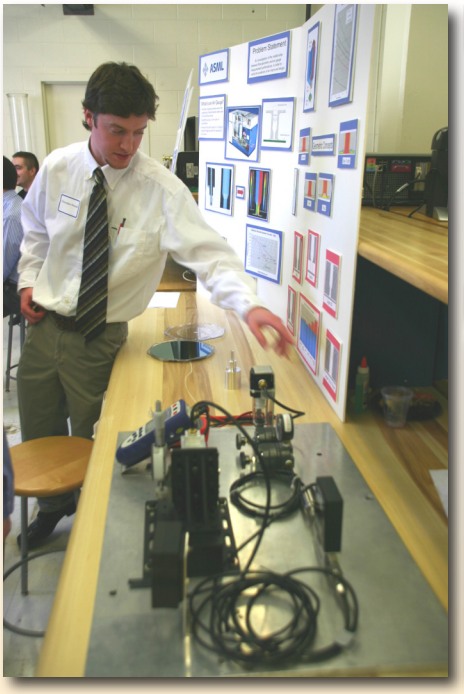
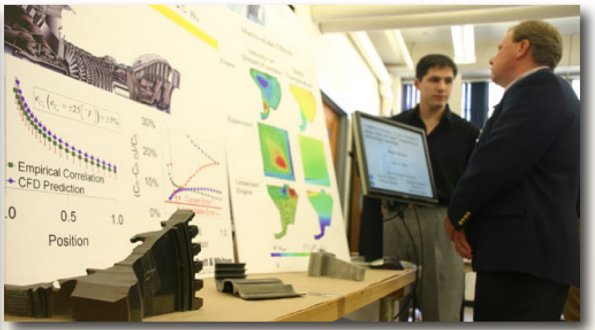




Asked what he enjoys most about teaching this course, Professor Barber notes that "The Senior Design Course highlights the breadth of Mechanical Engineering in Connecticut. Every year I have the chance to see twenty or more new problems and help with their resolution. For an inquisitive mind it's very exciting, and while I am not an expert in each area, I can rely on our outstanding team of faculty advisors to provide the necessary expertise." Professor Barber says that this exposure to a range of engineering possibilities can really pay off for students: "In order to truly develop their skills, we push students to work in a broad range of areas on their projects, not always in ways that the student sees the immediate need for. For example, we required one student to complete part of the project in Fluent, a widely used engineering software package. After graduating, the student was hired for a competitive position, and when they found out that he had experience in this software package they gave him a raise: before his first day of work. I received an email from him that said just "You were right!"

Tom Mealy, technician for the course and the department and a recent student in the class, says Professor Barber's dedication to excellence is central to the course: "His 'never enough' attitude and high standards show how any product, system or process can be improved. Even after the projects are done, he requires students to detail how the project could be enhanced from here and also how things could have been done differently to affect an even better outcome. He prepares students for what they will face once they leave, and makes it clear how important it is to stay competitive. 'Good enough' doesn't cut it."

"The Senior Design Course highlights the breadth of Mechanical Engineering in Connecticut"
Professor Thomas Barber

Professor Ranga Pitchumani, Distinguished Professor and Department Head of Mechanical Engineering, has been very satisfied with the accomplishments of the program. "The department's Senior Design Program is an excellent model for industry-university partnership in the undergraduate educational mission. Students gain valuable experience in solving industrial problems through a systematic approach of analysis-based design and prototyping, and industries often remark about the fresh solutions that they see come out of the program. In recent years, alumni who have gone through the senior design program themselves are taking on the role of industrial mentors from the sponsoring companies. It is rewarding to have them engage themselves closely in our educational activities. It is a win-win model, and the program continues to grow stronger each year."

Sponsors for the 2005-2006 Senior Design Project Course included Pratt & Whitney, Pitney Bowes, Gerber Technology, Miracle Industries, Pioneer Aerospace, Hamilton-Sundstrand, Westinghouse Electric, Sikorsky, Rogers Corporation, D. Flannigan DDS, Unilever, Otis Elevator, GlaxoSmithKline, OSIM International Ltd., Electric Boat Corporation, Wiremold Legrand, ASML, Siemon Company, Army Research Office, and the National Science Foundation. For more information on the senior design program, visit: **www.engr.uconn.edu/me/seniordesign**

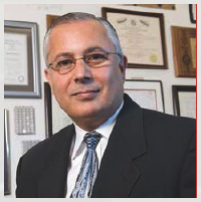
A Visitor from our Past

Dr. **Howard W. Butler**, former professor in the Mechanical Engineering department from 1941 to 1957, visited after almost 50 years.

During his visit to campus this April, he gave a talk to students and faculty on the second law of thermodynamics. The "blackboard and chalk" presentation provided a brief history of past efforts to resolve the Clausius Inequality, and suggested a new "broad concept" approach that "assigns specific names to the individual parts." Dr. Butler received his Master's and Doctoral degrees in Mechanical Engineering from Yale University, and his Bachelor's degree from the University of Rhode Island. Following his tenure as University of Connecticut professor, he went on to become Chairman and Professor in the Mechanical Engineering department at West Virginia University, a position he retired from in 1977. (Pictured left to right: *Professor Ugur Pasaogullari, Professor Baki Cetegen, Dr. Howard Butler, Professor Emeritus Win Hilding, Professor Michael Renfro and Professor Emeritus Lee Langston.*)

Alumni Profiles and News

This year, two Mechanical Engineering alumni were inducted into the School of Engineering Academy of Distinguished Engineers and Hall of Fame. **Bassel Daoud**, P.E. (B.S., M.S. Mechanical Engineering, '83, '85), is a Consulting Member of Technical Staff at Lucent Technologies Corporation, and holds the distinction of being the fourth most prolific inventor in the world in 2000, with 270 U.S. patents. Mr. Daoud was recently featured in the cover article of *Frontiers*, the School of Engineering newsletter, and commented on the value of his education: "Twenty years ago, I thought that UConn was one of the best universities in the USA; but now, UConn is even better than it ever was. It offers more extensive engineering programs that continuously reflect our current market needs. One thing that did not change was the devotion of the UConn faculty who are always eager to give their best in educating our students." (*Frontiers*, Winter 2006).



Stephen N. Heath (B.S. Mechanical Engineering, '73) is President of Pratt & Whitney's Commercial Engines business. He is responsible for the company's world-wide Commercial Engines operations, including overseeing a fleet of 15,000 engines, new and developmental engine program initiatives, customer and technical support, sales and marketing, new and serviceable spare part sales, and the airplane manufacturer liaison offices located in Toulouse, France and Seattle, WA. Mr. Heath progressed through a variety of leadership positions since joining the company in 1973, including President of International Aero Engines (IAE), a joint venture company with which Pratt & Whitney is a leading partner, which produces the V2500 engine for the Airbus A320 family of aircraft. Prior to this current assignment, he was Vice President of Commercial Engines Programs. Mr. Heath also has served as Vice President of Customer Service, Vice President of Marketing and Sales, and Director of Pratt's V2500 program. He serves on the Board of Directors of IAE; the Engine Alliance (EA), another joint venture company with Pratt & Whitney; and the P&W Institute of Collaborative Engineering (PWICE).

Rifat Sipahi (M.S., Ph.D. Mechanical Engineering, '02, '05) has accepted a faculty position in the Department of Mechanical and Industrial Engineering at Northeastern University, effective August 2006. He and his advisor, Professor Nejat Olgac, have recently developed a paradigm called the Cluster Treatment of Characteristic Roots (CTCR), which is the topic of both Dr. Sipahi's masters and doctorate theses (see www.engr.uconn.edu/alarm). This paradigm attracted attention in the mathematics and systems communities when it produced counterintuitive results regarding systems dynamics influenced by multiple and unrelated time delays. Dr. Sipahi was awarded a Chateaubriand Fellowship and is currently pursuing an extension of this research in Paris at l'Universite de Technologie de Compiegne. Sipahi was the 2002 winner of the ASME Best Student Paper Award on the same theme at the annual IMECE 2002 meeting.

John Krenicki, Jr. (B.S. '84, Mechanical Engineering) is President and CEO of GE Energy, a leading supplier of power generation technology, energy services and energy management systems. He was named to his current position in July 2005. Krenicki's General Electric career began in the Technical Marketing Program. Since then, he has progressed in the company through leadership roles at GE Plastics, Silicones and Structured Products. Krenicki was the CEO of GEBayer Silicones (a GE joint venture) in Erkarth, Germany, from 1997 to 1999. At that time, he was named a GE Company Officer and became a Vice President and General Manager of the Americas for GE Lighting. Krenicki was Vice President and General Manager of GE Superabrasives in Worthington, Ohio, before being promoted to President and CEO of GE Transportation Systems in June 2000. In January 2003, he was named a Senior Vice President of GE and President and CEO of GE Plastics. A year later, GE Silicones and GE Quartz were combined with GE Plastics to form GE Advanced Materials. Krenicki was President and CEO of GE Advanced Materials until July 2005. Asked about stand-out moments in his career, Krenicki comments: "I have had the opportunity to run two mechanical engineering divisions (Locomotives and Power Generation) and the chemicals/plastics operations at GE. Tackling difficult problems and building winning teams is most rewarding. We are competing and winning against the world's best in wind turbines, diesel locomotives and high performance materials, to highlight a few. It's a lot of fun executing through all kinds of cycles and dynamic environments." Krenicki earned a Bachelor of Science Degree in Mechanical Engineering from the University of Connecticut in 1984. He received a Master of Science Degree in Management from Purdue University.

Eric Landry (B.S. '05, Mechanical Engineering) has received a National Science Foundation (NSF) Graduate Research Fellowship for his graduate studies at Carnegie Mellon. He is one of the only 49 fellowship recipients nationally in the field of Mechanical Engineering in 2006, and the first UConn ME alum to receive an NSF Graduate Fellowship.

Congratulations to our alumni on their achievements!

Keep in touch!

Give us your feedback and updates for future issues of **Linkages**. Use the form to the right to update us on address changes, to select email delivery of **Linkages**, or to make a tax-deductible gift to the department. Contact us at ejerome@engr.uconn.edu or at our mailing address on the inside front cover.

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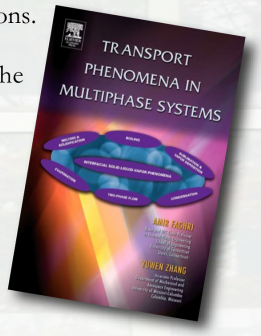
Faculty News

Professor **Wilson K. S. Chiu** was recently selected to receive the 2006 ASME Bergles-Rohsenow Young Investigator Award in Heat Transfer. Wilson was selected for this honor for his "research in computational and experimental heat transfer, particularly chemical vapor deposition systems." Established by the Heat Transfer Division in 2003, the award was funded through the efforts of Arthur Bergles and Warren Rohsenow, who are well known for their accomplishments in heat transfer research and for their mentoring of young researchers. This award is given each year to a young engineer who is committed to pursuing research in heat transfer, and has demonstrated the potential to make significant contributions to the field.

Professors **Michael Renfro** and **Baki Cetegen** received a three-year $200,000 National Science Foundation grant under its GOALI program for university-industry partnership. Titled *Experimental and Computational Study of Bluff-body Flame Stabilization with Nonhomogeous Upstream Mixing*, the research will focus on flame stabilization in premixed combustion. The study employs experimental and computational components to better define the flame anchoring mechanisms in aircraft engine augmenters and other high intensity combustion devices. The experimental study will utilize advanced optical laser diagnostic measurements. The computational effort will be performed in collaboration with the United Technologies Research Center.

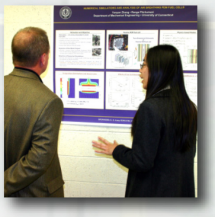
Professor **Horea Ilies**, featured as one of our new faculty members in the Winter 2006 issue of **Linkages**, was awarded a three-year $320,000 grant from the National Science Foundation to develop Constrained Geometric Morphing (COGEM) as a novel generic mechanical design framework that will allow intuitive geometric modifications of arbitrarily complex baseline designs via shape morphing (deformation) procedures while preserving key prescribed geometric parameters. Dr. Ilies is also serving as an Associate Editor for a special issue of the ASME Journal of Biomechanical Engineering on Medical Devices.

Three fundamental textbooks in the field of thermal and fluid sciences were published this year. Professor **Ted Bergman** co-authored the sixth edition of *Fundamentals of Heat and Mass Transfer* and the fifth edition of *Introduction to Heat Transfer*, both published by John Wiley and Sons. The two books are among the most widely used textbooks in the undergraduate mechanical engineering curriculum worldwide. United Technologies Endowed Chair in Thermal-Fluids Engineering **Amir Faghri** is a co-author with Dr. Yuwen Zhang (Ph.D. '98) (profiled in the Winter 2006 issue of **Linkages**) of *Transport Phenomena in Multiphase Systems* published by Elsevier Academic Press.



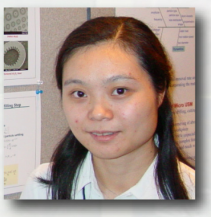
Graduate Student News

The **Graduate Student Research Competition** held this past spring provided Mechanical Engineering doctoral candidates with a chance to present their research findings to peers, faculty and the engineering community, and to compete for fellowship prize awards. Twelve students participated in the event and presented talks on their research covering a range of subjects including modeling and analysis of fuel cells, granular damping mechanisms, and failures in micro-electro-mechanical systems (MEMS). The students also presented a poster on their work to the audience of industrial visitors on Senior Design Demonstration day in late April.



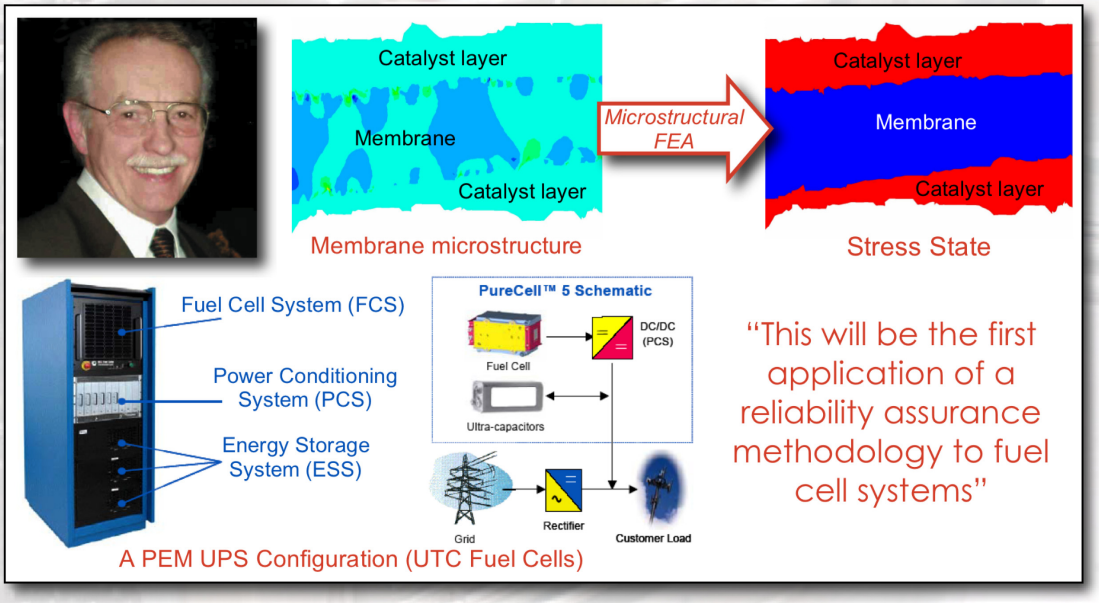
Graduate Predoctoral Fellowship awards were granted for the best presentations after the poster showing. Richard Johnson (Advisor: Professor Pitchumani), who presented on 'Localized Heating Based Flow Control of the VARTM Process,' and Ali Fuat Ergenc (Advisor: Professor Olgac), who presented on 'A New Optical Sensor for Monitoring Micro-Pipette Motion' tied for third place, each receiving a fellowship in the amount of $1,100. Srinath Chakravarthy (Advisor: Professor Chiu) placed second for his presentation on the 'Reliability of Carbon Coated Optical Fibers,' receiving an award in the amount of $1,500. William Carnell (Advisor: Professor Renfro) won first prize for his presentation 'Fire and Lasers: A Study of Flame Extinction using Optical Diagnostics.' He received a fellowship in the amount of $1,800. Congratulations to all the winners and the participants for an outstanding set of presentations. For more details on the event visit **www.engr.uconn.edu/me/GDPweb**. A copy of the Graduate Student Research Competition poster book is available from ejerome@engr.uconn.edu.

Graduate student **Yan Xiao** was the recipient of a $1,000 National Science Foundation (NSF) award to attend and present her research at the 2006 NSF Design, Service, and Manufacturing Grantees and Research Conference in St. Louis in July 2006. Yan is working in the *Advanced Materials and Technologies Laboratory* with Professor Ranga Pitchumani on a novel process for ceramic and metallic micropart fabrication. Her research, funded by NSF, is aimed at establishing a fundamental understanding of the governing physical phenomena involved in the fabrication in order to guide process development and commercialization. Travel grants were awarded competitively to 77 students from a pool of over 300 applicants, to cover costs of recipients' airfare, conference registration and accommodations.



Fuel Cell UPS for Telecom

Backup or uninterrupted power systems (UPS) must provide highly reliable power on demand after long periods of idling. Hydrogen fueled polymer electrolyte membrane (PEM) fuel cells are ideally suited for such applications, but potential customers, such as wireless network providers, require better information about the long-term reliability and availability of this technology. One of the major research thrusts of the Connecticut Global Fuel Cell Center (CGFCC) at the University of Connecticut is the durability and reliability of fuel cells and systems. Professor **Kenneth Reifsnider**, Pratt and Whitney Endowed Chair in Design and Reliability and Director of the Center, Dr. **Xinyu Huang**, Research Assistant Professor of Mechanical Engineering, and Trent Molter in partnership with UTC Fuel Cells were awarded $300,000 from Connecticut Innovations Inc. with an additional $300,000 from UTC Fuel Cells for a project under the Yankee Ingenuity Technology program. The project aims to develop fuel cells for distributed telecom backup power applications. The research focuses on the development of accelerated reliability testing capability, protocols, remote monitoring and on-site diagnostic hardware and software, which will enable the advancement of PEM fuel cell UPS as a compelling solution for telecom backup power and other applications. The scientific approach will involve accelerating relevant PEM failure mechanisms and degradation modes of the prime-reliant components of PEM stacks, and capturing the degradation processes through in-situ monitoring, intermittent diagnostics, and post-test analysis. Based on the test results and analysis of the process, the team will develop a methodology to enable the reliability projection of individual PEM UPS units using their specific duty cycles and environmental weathering history. The work will build on unique capabilities developed by the team for the characterization of the mechanical behavior of polymer electrolyte membranes under varying conditions of hydration and temperature, over wide ranges. The research group uses a microstructural finite element based method where the actual microstructural geometry of a membrane cross section was used to conduct a micromechanical analysis of the stress-strain state, including the concentrations of stress and strain caused by the irregular geometry actually measured. "These results are in strong contrast to values estimated by analysis of idealized geometries which assume that the layers have uniform thickness and the boundaries are regular," comments Reifsnider, who is a pioneer in the concepts of damage tolerance and durability of materials and author of *Damage Tolerance and Durability of Material Systems* (Wiley, 2003). According to Reifsnider, "A key innovation of this program will be the development of a novel reliability projection methodology that leverages a concept developed in the turbine and jet engine industry to greatly enhance reliability, while reducing the cost of maintainability. The concept uses remote health monitoring connected to predictive modeling of system degradation, sometimes called 'stimulated simulation.'" Reifsnider adds: "This will be the first time such a methodology has been developed and applied to a fuel cell system." The program will demonstrate the effectiveness of this innovative reliability assurance methodology, and enable rapid insertion of fuel cell based backup power systems for the telecom industry.

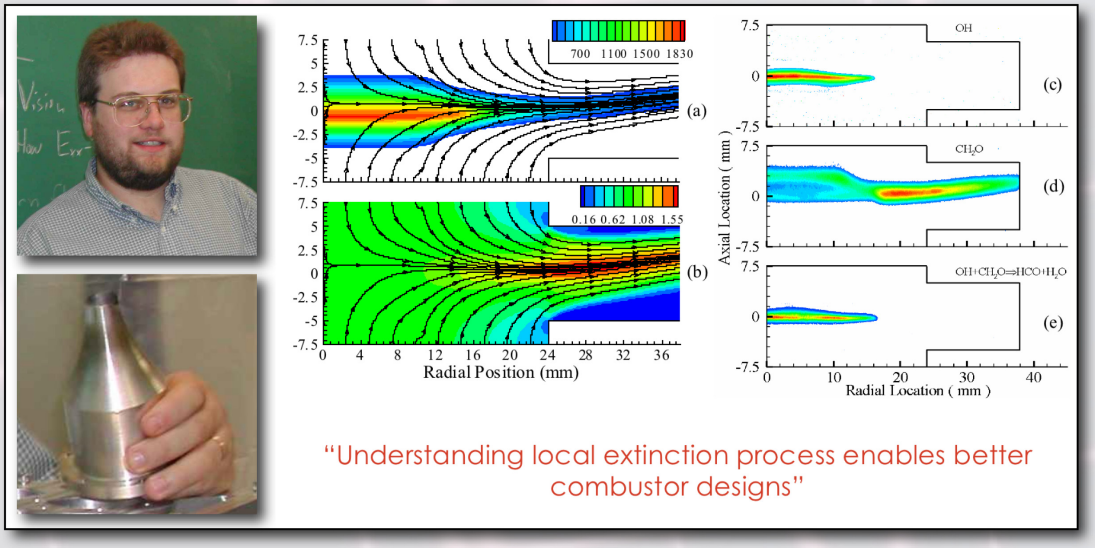


Professor Reifsnider holds the Pratt & Whitney Endowed Chair in Design and Reliability in the Mechanical Engineering Department. He is the Director of the Connecticut Global Fuel Cell Center (www.ctfuelcell.uconn.edu) and a member of the National Academy of Engineering. For more information on his research contact Professor Reifsnider at reifsnider@engr.uconn.edu

Local Extinction in Flames

Advanced combustor designs rely on rapid mixing of fuel and air to provide cooler flames and lower pollutant production. This rapid mixing is enabled by complex turbulent flow fields that have high levels of fluctuations in the velocity of the fuel and air gases. In some cases, it is possible for the local mixing to be so fast that chemical reactions cannot occur, which leads to local extinction. Professor **Michael Renfro** and his students in the *Optical Diagnostics Laboratory* study flame extinction using laser diagnostics to measure chemical and thermal conditions occurring inside flames. According to Renfro, "Understanding this local extinction process enables better combustor designs that either avoid local extinction or take advantage of it to control the nature of the combustion process." To this end, a Nd:YAG laser pulse is used to measure the local temperature at a point where a flame is extinguished by high speed gas flow—a phenomenon that can occur in gas turbine engines. In this project, the investigators have developed a simple laboratory combustor that can produce a stable local extinction process. Experimental measurements of the local

chemical constituents and gradients in the fuel and air, which lead to mixing, were made and used to assess the conditions that cause extinction. Renfro's research group has shown, through these measurements and complementary numerical simulations, that the local extinction process is not only dependent on local mixing, a theory that has been proposed in the literature, but also on flame temperatures upstream of the extinction point, and on absolute velocities at the extinction point. A correlation for the effect of advective heat transfer through the flame edge on the onset of local extinction was developed from the numerical work. Renfro summarizes the significance of his work: "this improved understanding of the extinction process can be used as a simplified model in more complex turbulent combustion simulations; in addition to this phenomenological understanding of extinction, the stable flame combustor set up in our laboratory enables a comprehensive study of chemical kinetics through extinction processes." Measurements made using planar laser-induced fluorescence (PLIF) of flame species such as hydroxyl and formaldehyde can be combined to estimate reaction rates which are important contributors to heat release near extinction. These measurements are then compared to detailed chemical kinetic simulations of the flame to assess advanced models for prediction of extinction chemistry.



"Understanding local extinction process enables better combustor designs"

Professor Renfro joined the Mechanical Engineering Department in 2002 from Purdue University where he was a Visiting Assistant Professor following completion of his Ph.D. in 2000 from Purdue. He received the NSF CAREER Award for his research featured here, in 2003. For more information contact Professor Renfro at renfro@engr.uconn.edu

Damage Detection by Structronics Approach

At the *Structures and System Dynamics Laboratory*, Professor **Jiong Tang** and his students perform research on a series of topics involving dynamical systems, sensing and monitoring, and control. One research focal point is the damage detection and diagnosis of structures, which has potential application for aerospace structures and infrastructure. Funded by two major programs under the Sensors Team initiative of the National Science Foundation (NSF), Professor Tang and his students are developing a structronics approach for damage detection and identification. Piezoelectric materials produce a strain when subjected to an electrical field and conversely, produce a charge when strained mechanically. In the structronics design methodology, electronic elements are directly integrated into the structure, with the piezoelectric material serving as an energy transducing interface between the mechanical and the electrical regimes. From a system dynamics standpoint, typical circuitry elements, such as capacitor, resistor, and inductor, are analogous to mechanical stiffness, damping, and mass elements. Professor Tang comments that "with advanced circuitry design using operational amplifiers, one can further develop adaptive and reconfigurable circuitry. The circuitry elements thus provide much greater design flexibility for new applications involving the piezoelectric material." Over the past several years, Professor Tang has successfully utilized the structronics methodology to achieve vibration confinement (by confining vibratory energy to unimportant areas and to the circuitry elements), vibration de-localization in periodic structures such as engine bladed-disks (using circuitry elements as energy propagation channels to relieve the unwanted vibration localization), and high precision robust control with hysteresis cancellation. Speaking about an innovative circuitry tuning algorithm developed by his group, Professor Tang explains that "using the new algorithm, an adaptive piezoelectric sensory circuitry integrated to the structure yields a family of frequency response functions that characterize the damage influence more completely, which significantly improves damage detection accuracy and robustness." In a related effort, Professor Tang's research group is exploring wave propagation based damage detection using piezoelectric material, with particular focus on the detection robustness. "The issue is: how to differentiate the signal anomaly caused by the damage from that caused by the measurement noise and uncertainty," Professor

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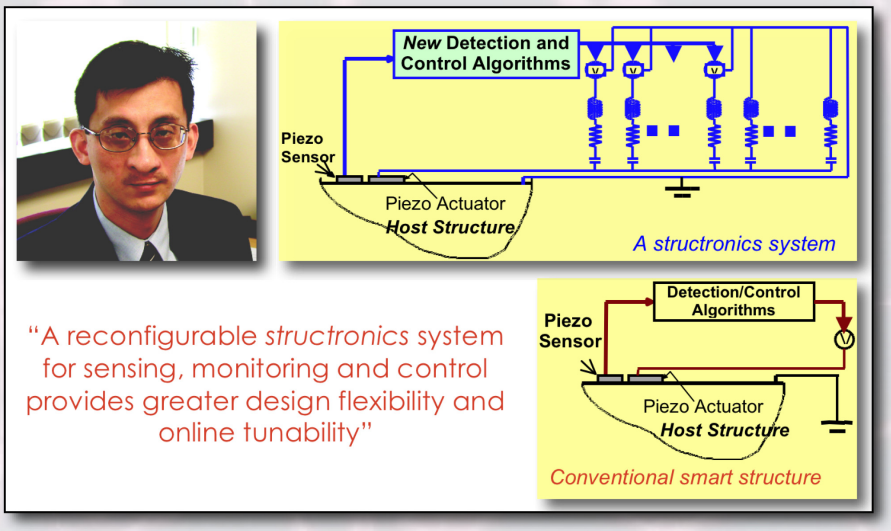

"A reconfigurable *structronics* system for sensing, monitoring and control provides greater design flexibility and online tunability"

Tang elaborates, "To deal with this issue, we are developing advanced signal processing tools such as adaptive wavelet transform for feature highlighting and multivariate statistical analysis methods for sensor de-noising and robust decision making." The eventual goal of Professor Tang's research on structural damage detection is to develop an autonomous sensor network system that has high sensitivity and robustness and can be incorporated into a wireless setting. Some of the above-mentioned analysis tools have already been utilized in practical applications, such as engine bladed-disk damage detection (sponsored by Pratt & Whitney). Another long-term interest of Professor Tang is vibration control and damping. Professor Tang has published extensively on passive, active, and active-passive hybrid control of structural vibrations. Recently, as part of another NSF-funded program, Professor Tang and his students are exploring granular damping as a very promising approach for damping in high-temperature applications. Professor Tang explains the underlying mechanism of granular damping as "the energy dissipation/absorption through impact/collision among the granules and between the granules and the enclosure." A series of analysis tools have been developed to study this damping method, including discrete element analysis, Monte Carlo approach, and a multi-phase flow approximation. Professor Tang highlights the results as "our studies have provided new insights into this highly nonlinear damping mechanism, and have also enabled the optimal design of granular damper for practical applications." Professor Tang's research extends beyond structures to the field of alternative energy. His group is also working on the analysis, control, and online monitoring of polymer electrolyte membrane and solid oxide fuel cells. Their particular interest is in fuel cell behavior at the system-level, with a focus on the optimal design and control of fuel cells to maximize their overall performance.

Professor Tang received the Ph.D. degree in Mechanical Engineering from The Pennsylvania State University in 2001, and worked as a staff research engineer at GE Global Research Center, NY prior to joining the University of Connecticut in August 2002. For more information on his research contact Professor Tang at jtang@engr.uconn.edu

UConn ME at a glance

2	National Academy of Engineering members
3	Editors-in-chief of leading journals
5	Endowed Chair and Distinguished Professors
7	ONR/ARO Young Investigator or NSF CAREER Awardees; Graduate program ranking among all public universities in the Northeast and Mid-Atlantic states (*2007 U.S. News & World Report*)
9	Fellows of The American Society of Mechanical Engineers (ASME)
13	Textbooks, book chapters and edited volumes authored by faculty during 2005–2006
19	Associate editors or editorial board members of leading journals
24	Faculty members
25	Senior design projects sponsored during 2005–2006
38	Per-faculty peer citation average (2005)
59	Refereed journal articles authored by faculty during 2005–2006

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