Spring 2013

MECHANICAL ENGINEERING VIBRATIONS

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University of Kansas Learned Hall Room 3138 1530 W. 15th Street Lawrence, KS 66045

Meet the New Department Chair

Dr. Theodore (Ted) Bergman became the new Department Chair in September of 2012. He also holds the Charles E. & Mary Jane Spahr Professorship. Professor Bergman was formerly at the University of Connecticut where he served as Head of the Mechanical Engineering Department for nearly 7 years, and was Associate Dean for Research and Outreach in the School of Engineering for about 3 years. He also spent time as the Interim Head of the Department of Materials Science and Engineering at UConn, and took two years academic leave from UConn to work in the Directorate for Engineering at the U.S. National Science Foundation (NSF) from 2008 to 2010. From 1985 to 1996, Dr. Bergman was a faculty member in the Mechanical Engineering Department at The University of Texas at Austin. He received his Ph.D. and M.S. degrees from Purdue, and his B.S. degree from KU. He has received numerous national awards including the NSF Presidential Young Investigator Award from President Ronald Reagan, the ASME Melville Medal, and four Certificates of Appreciation from ASME and NSF.

Dr. Bergman teaches and conducts research in the thermal sciences, particularly heat transfer and thermodynamics as applied to energy generation and advanced manufacturing. With colleagues at UConn and Virginia Tech, he is currently investigating fundamental phenomena that will enable the engineering design of very large scale thermal energy storage systems for concentrating solar power applications. These storage systems include phase change materials and incorporate advanced heat transfer concepts to ultimately reduce the cost of electric power produced from the sun. On the education front, Dr. Bergman is a co-author (currently the lead author) of the most widely-used and highly-cited heat and mass transfer textbooks in the world.

Having been raised on a farm outside of Seneca, Kansas, Dr. Bergman reports that he is excited to be returning home. His wife, Patricia, is a mechanical engineer with her B.S. degree from Purdue. Their two sons, Nate and Tico, are currently studying mechanical engineering at Purdue and Penn State, respectively.

Dr. Bergman's arrival at KU also marks the close of Ron Dougherty's service as Chair of KUME for nearly 13 years. According to Dr. Bergman, "It is extremely rare that a university administrator serves in any capacity for such a long time. Ron's long and successful tenure as Chair reflects the extraordinary level of admiration and respect afforded him by the faculty, the upper administration at KU, KUME students and alumni, and the many friends of KUME. Under Ron's leadership as Chair, departmental enrollments and research activity increased dramatically. Ron's dedication to KUME has been truly remarkable, he has selflessly assisted in my transition to KU, and I am looking forward to Ron's many contributions in the department for years to come."

Dr. Dougherty handing Dr. Bergman the keys to the department.

New EcoHawks Teaching and Research Facility Under Construction

The KUME EcoHawks design program is supervised by Assistant Professor Christopher Depcik with a student-defined mission to attain "A Sustainable Approach to Automobiles and Energy Infrastructure." According to Professor Depcik, the students' definition of sustainability involves the application of engineering principles to solve real-world problems by holistically approaching design challenges from five vectors of success: energy, environment, education, economics, and ethics.

The EcoHawks program introduces undergraduates to research in their capstone design class using projects ranging from the conversion of a 1974 Volkswagen Super Beetle into a 100+ MPG-equivalent hybrid plug-in electric vehicle, to the drying of poplar for co-combustion with coal in the North Lawrence power plant. Since 2008, EcoHawks students have won five undergraduate research awards and generated four technical peer-reviewed publications. The awards include an Honorable Mention in the 2011 P3 People, Prosperity and the Planet Student Design Competition for Sustainability organized by the U.S. Environmental Protection Agency. Moreover, they were named the Student Organization of the Year for Academic Enrichment in 2009-2010 by the KU Student Involvement & Leadership Center. Numerous EcoHawks students have continued on to graduate school at KU and elsewhere.

Since its inception in 2008, the EcoHawks program has undergone rapid expansion, quickly outgrowing their current makeshift facility. In the Fall of 2012, a unique opportunity presented itself to collaborate with another KU student organization, Studio 804, to design and construct a modern and attractive teaching and research facility for the EcoHawks. Studio 804, led by Dan Rockhill, the J. L. Constant Distinguished Professor of Architecture at KU, is committed to the continual research and development of sustainable, affordable, and inventive building solutions. It consists primarily of graduate students entering their final year of the Master of Architecture program at the KU School of Architecture, Design and Planning. Studio 804 students have completed one building per year for each of the past 20 years, continually pioneering new energy-conserving technologies and advanced construction techniques. Completed facilities include five LEED Platinum projects (three certified, two pending).

The new EcoHawks facility, made possible by the Studio 804 – EcoHawks collaboration, is currently under construction on West Campus with an anticipated completion date of May, 2013. It will provide the EcoHawks program with an iconic 3500 square foot building that will house a wide range of teaching, research, and outreach activities. The facility will have indoor and outdoor areas designed to showcase student work, and will include space for computer workstations, as well as an area for students to test and investigate various forms of alternative energy and power sources. Consistent with previous Studio 804 projects, the new EcoHawks facility will incorporate numerous passive and active sustainable energy and water systems and technologies with the goal to achieve LEED Platinum certification.

According to KUME Department Chair Ted Bergman, the new EcoHawks facility will be part of an enhanced engineering presence on West Campus that will anchor many of KUME's growing energy-related teaching, research, and outreach activities. Readers who are interested in contributing materials or supplies toward construction of the new EcoHawks facility, or potentially naming various EcoHawks laboratories and workspaces, should contact the Mechanical Engineering Department.

Studio 804 rendering of new KUME EcoHawks building.

End of an Era: Professor Umholtz Retires

After nearly 60 years as a faculty member at KU, Bob Umholtz retired at the conclusion of the Fall, 2012 semester.

A native of Miami, Oklahoma, Bob was raised in Topeka, where he ultimately became student body president and valedictorian of the class of 1946 at Highland Park High School. Professor Umholtz went on to receive his Bachelors and Masters degrees in mechanical engineering from KU in 1951 and 1956, respectively. Between his KU degrees, Bob served in the Korean conflict as well as in industry. He began teaching at KU in 1953, and has always been heavily engaged in student-centric service including three stints as Associate Chair of the department from 1973 – 1979, from 1987 – 1990, and from 1991 – 2012.

Known to generations of KUME students as "Bullet Bob" because of his distinctive lecturing style and staccato chalkboard skills, Professor Umholtz not only taught thousands of KU mechanical engineering students, but also academically advised most of them over the past six decades. In recognition of his dedication to student success, Bob has received the Wesley G. Cramer Mechanical Engineering Faculty Award in 1993, the ASME (KU student section) Distinguished Professor Award in 1997, and the Wesley G. Cramer Professorship in Mechanical Engineering in 2001. Professor Umholtz was named a KUME Distinguished Alumnus in 2002, and was granted emeritus status in the Fall of 2012.

The following is but a small sample of the many comments we've received regarding Bob's influence on KUME. "Professor Umholtz knew his subject forward and backward, and that was clear in his lectures. Most would agree that he is faster than a speeding bullet in equation writing," notes LaRoux Gillespie (B.S., 1965; M.S., 1968). Bethany Pearson (B.S., 2006) recalls "I spent a summer with my student office next to Bob's, and I saw him in a different light than when he was a lecturer. In addition to being a stalwart faculty member committed to the fundamentals of the engineering curriculum, he is warm, funny, and caring about the students and their education." Robb Sorem (B.S., 1986; M.S., 1988; Ph.D., 1991) who graduated from KUME as did his brother Jim (B.S., 1978; Ph.D., 1985) and sister Jenifer Rivera (B.S., 1983) shares that "My son, who will be in his fourth semester in KUME this Spring, would have taken a class from Bob. He is disappointed that this won't occur after enjoying all of my family's 'Umholtz stories.' Bob hasn't changed in the 25 years since he taught my Dynamics class (he's still as cantankerous as ever!)" Ted Bergman (B.S., 1978) added, "Wherever I go and with whomever I speak, one of the first questions I'm asked when it becomes known that I'm a KUME graduate is whether I took classes from Bob. He has left a lasting impression on literally thousands of KUME students." According to Professor Emeritus Louis Burmeister, "Bob was a cordial colleague when I joined the KUME faculty, and his cordiality never changed. Like most professors, Bob had a specialty. His was mechanisms, a topic at the core of mechanical engineering. He was the first in the department to teach mechanical vibrations and automatic feedback control. He incorporated the analog computer in his courses, and taught its programming and use." Bedru Yimer, who has worked alongside Bob on the KUME faculty for the past 35 years perhaps puts it best, "Bob truly has the heart of a saint. Throughout his entire career he genuinely enjoyed serving and helping others, especially students."

The entire KUME family wishes Bob a very enjoyable, happy, and active retirement.

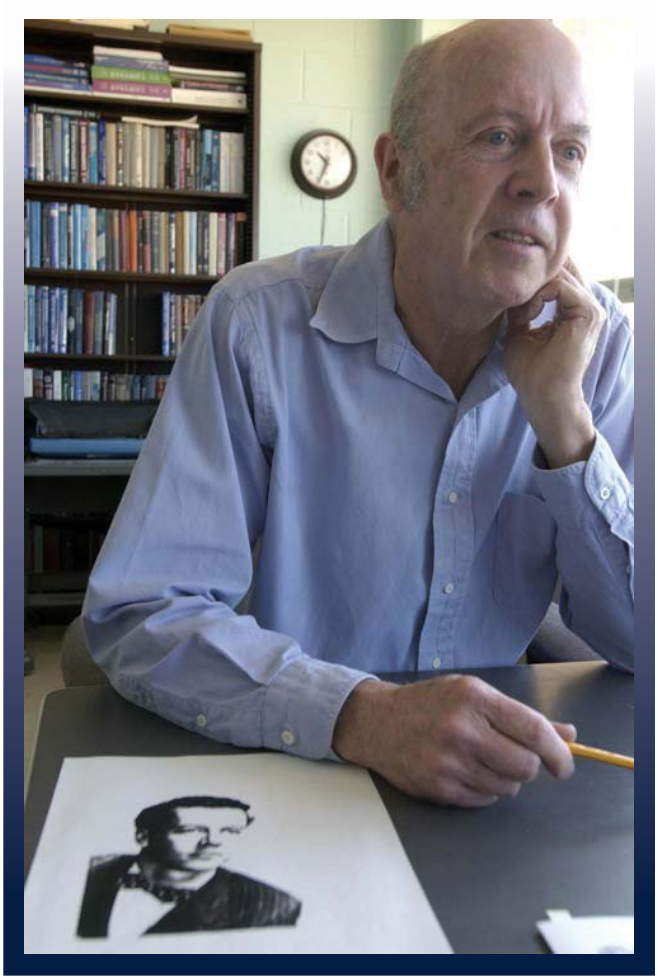

Photo by Mike Yoder/Journal-World Photo

Bioengineering Update

At a meeting in Bethesda, Maryland this past June, the National Cancer Institute (NCI), which is part of the National Institutes of Health (NIH), recommended The University of Kansas Cancer Center be designated as a NCI Center. As a result, patients in our region will now have access to clinical trials that are available only at NCI-designated Centers, and KU faculty members will be eligible to apply for federal research grants that are available only to researchers affiliated with such centers. This high-profile news followed the recent identification of four new strategic initiative themes at KU, one of which is "Promoting Well-Being, Finding Cures." Over the past 15 years, KUME has invested heavily in bioengineering and biomedical engineering, and we have received many inquiries as to how KUME might contribute to, and benefit from these recent developments.

According to Professor Lisa Friis, "NCI designation will serve as a magnet, and will allow KU to more effectively recruit top faculty members who are conducting cancer-related research. Many will want to collaborate with KUME faculty. The designation may also allow KUME to hire new faculty who utilize engineering approaches in their cancer-related research." Ted Bergman, KUME Chair, explains one such approach. "In my area of heat transfer, engineers are synthesizing nanoparticles composed of specific materials and of very specific size. Working with chemists, the particles are treated so that upon injection into the body, they actively seek out cancerous cells and attach themselves to the cells. Once these 'smart nanoparticles' are ensconced, a laser operating at a wavelength equal to the particle diameter passes its beam harmlessly through the body, but heats the particles and, in turn, thermally destroys the cancerous cells while leaving the surrounding healthy tissue intact." With funding from NIH, Professor Xinmai Yang is developing optical and acoustical methods for early cancer detection that could promote more effective usage of many advanced treatment approaches. According to Dr. Yang, "As an associate member of the Cancer Center, the NCI designation will provide more opportunities for my detection methods to be used by others, and will help me establish new collaborations to accelerate more effective detection and treatment of cancer." Professor Sarah Kieweg adds, "Professor Terry Faddis and I have already designed and patented medical innovations with Cancer Center researchers. NCI designation will draw top-notch faculty candidates to KU, including bioengineering candidates, and will increase collaborations between KUME and researchers at the KU Medical Center (KUMC). This will lead to innovations in fields such as orthopaedics, obstetrics/gynecology, cardiovascular device development, and human motion."

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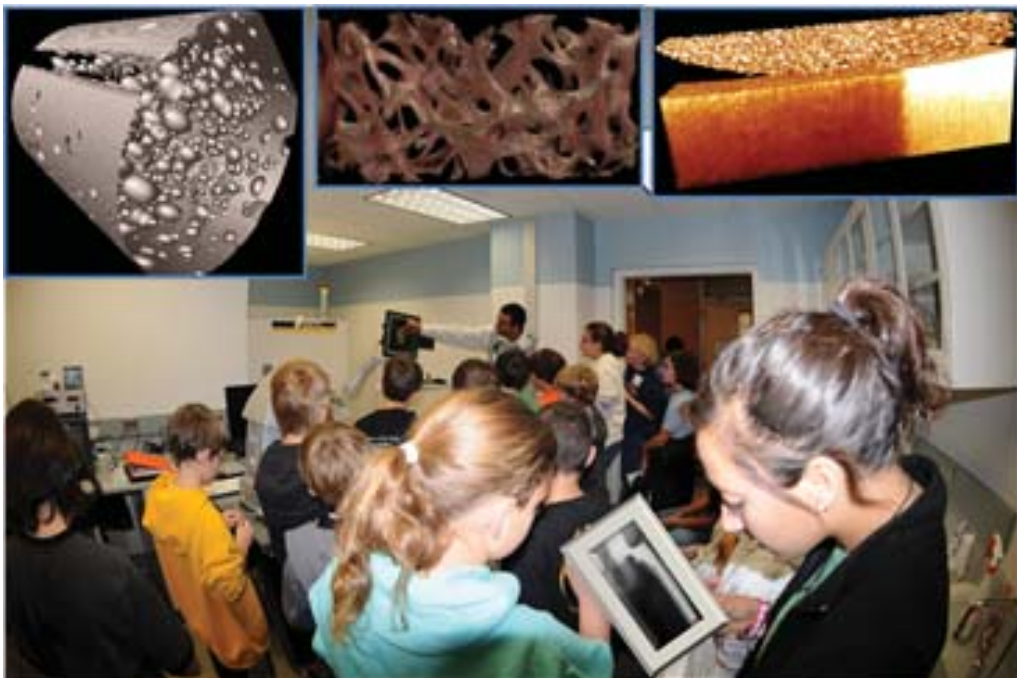

KUME faculty in the Bioengineering Research Center use state-of-the-art imaging, measurements, and computer simulations to develop new synthetic materials and test their efficacy. Artificial tissue is shown. Bottom: KUME graduate students work with K-12 students to illustrate how engineering principles are used to address biomedical problems.

Mehdi Jalayerian: From Treetops to SuperTalls

Mehdi Jalayerian's path to KU did not follow a usual route. As unrest in Iran was accelerating in the late 1970s, Mr. Jalayerian sent his application materials to scores of universities in England, Australia, India and the United States. Knowing little about the University of Kansas, Mehdi decided to enroll at KU "because it was the first university that accepted me." Traveling alone from Iran to Lawrence was a great adventure for the young Jalayerian, with the final leg being a brief and bumpy flight from KCI to the Lawrence Airport on the day before Thanksgiving. "It was a two-seater, and we flew just above the treetops," recalls Mehdi. Noticing he was the only passenger at the Lawrence airport, he asked the pilot for directions. Following the advice he was given, Mehdi walked to a small motel a few yards from the runway where he spent his first night in America.

The next day, a snowy Thanksgiving, Mehdi arrived on the KU campus only to find it closed. Mr. Jalayerian remembers that "Because universities in Iran closed whenever there was student unrest, I called my mother and relayed my deep disappointment that there must be unrest at KU too." From his motel, he called every familiar-looking name in the phone book to seek help, and was soon befriended by another student from Iran who explained the curious American holiday of Thanksgiving, and made sure Mehdi had a safe place to stay.

Ultimately, Mr. Jalayerian received his B.S. degree in mechanical engineering from KU, and again applied to many universities to pursue an advanced degree. Again, he accepted KU's offer and completed his master's thesis under the guidance of Professors Burmeister, McBride, and Yimer. Upon graduation, Mr. Jalayerian accepted employment at an oil company in Chicago only to learn that, upon reporting for work, his job had been eliminated because of a weak economy. The determined and resourceful Jalayerian again refused to be deterred, and sought employment at the Chicago architecture - engineering firm of Skidmore, Owings and Merrill. He was hired, and Mr. Jalayerian eventually became the youngest Associate Partner in the firm's history.

Today, Mehdi Jalayerian is Executive Vice President of Environmental Systems Design (ESD) in Chicago. Founded in 1967, ESD has provided engineering design solutions for thousands of buildings and other structures throughout the world including iconic landmarks such as the Willis (Sears) Tower which held the record for the world's tallest building for 25 years. Leading ESD's international and commercial projects from his base in Chicago, Mr. Jalayerian also manages ESD's office in Abu Dhabi, and oversees the firm's office in Saudi Arabia.

Mehdi's current projects include the Kingdom Tower in Jeddah, Saudi Arabia which will be the first building in the world to reach 1 kilometer in height, more than twice as tall as the Willis Tower. Another is Masdar Headquarters in Abu Dhabi which will be the world's first positive-energy large-scale building, producing more power than it consumes. According to Mr. Jalayerian, "The supertalls can be thought of as cities standing vertically, leading to many engineering challenges. For example, water pressures are very high, easily exceeding 600 psi, necessitating development of new heat exchanger technology. Power distribution is very complex, and requires use of voltages that are higher than found in traditional structures. Air handling and thermal control is a particular challenge because outside temperatures at the top of a 1 km tall structure are 10 degrees Fahrenheit cooler than at the

Continued on Following Page

Artist rendering of Masdar Headquarters.

KUME Alumni Focus (cont.)

bottom, and the air at the top is less turbid, resulting in higher solar gain at the upper floors relative to the lower floors. Safety challenges abound, with elevators designed to serve as 'vertical lifeboats' capable of evacuating tens of thousands of occupants in minutes." Because of his unique experience and many accomplishments, Mr. Jalayerian is today considered to be the world's foremost expert on the engineering design of supertall structures.

Looking back on his time at KU, his life experiences and his career achievements, Mr. Jalayerian offers the following advice for engineering students and young engineers. "Study hard in your difficult classes, and build on the fundamental theories you learn in school. Apply those theories to important practical problems, and take chances and risks. And, view any setback along the way as a learning opportunity so you can do better next time." Clearly sage advice for all, as we aspire to our own great heights.

Artist rendering of Kingdom Tower.

Bioengineering Update (cont.)

"I'm very excited about the new strategic theme," says Professor Carl Luchies. "My research program, with funding from NIH and in collaboration with Drs. Cheney, Lyons, and Pahwa of KUMC, along with Mrs. Clark (a Physical Therapist in Lawrence) has focused on understanding the mechanisms underlying the effects of age, neurological disease (such as Parkinson's disease) and intervention on human motion control, with the long term goal to use engineering methods to extend and improve the quality of life. Our partnerships with scientists and clinicians at KUMC facilitate the translation of discovery to therapies and devices that will improve patient care in a clinical setting."

With support from NIH, the research team working with Professor Paulette Spencer, Director of the Bioengineering Research Center is exploiting biologic concepts to engineer new bio-inspired materials. As an example, when synthetic materials are used to replace damaged tissues, the surrounding tissue may become inflamed. Inflammation can lead to an acidic micro-environment that will degrade polymeric biomaterials. According to Dr. Spencer, "We are designing polymers that will act like 'proton sponges' to buffer the acidic micro-environment and thus, potentially reduce the damage to the biomaterial and the surrounding tissue." Professors Sara Wilson and Sarah Kieweg have been working with an obstetrician, Dr. Carl Weiner, to apply engineering analyses to obstetrical techniques that will help physicians more safely deliver newborns. "By measuring the kinematic forces and contact pressures the physician exerts on the newborn head as the baby is delivered, we are working to define safe delivery techniques and to create a training protocol for early career physicians," says Dr. Wilson. Enabled by funding from NIH, Dr. Kieweg is also collaborating with biologists, engineers, and a physician to improve delivery of anti-HIV drugs. KUME faculty members are also creating new medical intellectual property and working with industry to translate the research to practice. One example is given by Professor Friis. "With funding from the National Science Foundation and assistance from industry, we have learned new methods of entrepreneurship and have applied them to a spinal fusion implant product being developed in our laboratory. We are now having discussions with a major medical device manufacturer to license the product to improve the lives of patients worldwide."

2012 Graduates

Graduate Students

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Kayla Klein
Nick Tobaben
Michael Mangus
Preston White
Daniel Nunez
Mutasim Shlghom
Luis Quios
Michael Knopp

Undergraduate Students

Keaton Andra
Thomas Balough
Michael Balsbaugh
J. D. Baughman
Dustin Bergstrom
Ryan Bittel
Joseph Bridgewater
Justin Burwinkle
Tyler Busch
Steven Callen
Austin Carnes
Kevin Chael
Jonathan Collins
Patrick Collins
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Brandon Davis
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Andrew DeLapp
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Jordan Dykes
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MECHANICAL ENGINEERING VIBRATIONS

On the cover: Graduate student Erin Mannen demonstrates laboratory procedures to undergraduates Myette Simpson and Emily Schapker in the spinal research laboratory of Prof. Lisa Friis.

Photo Credit: David McKinney

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