

Fall 2008

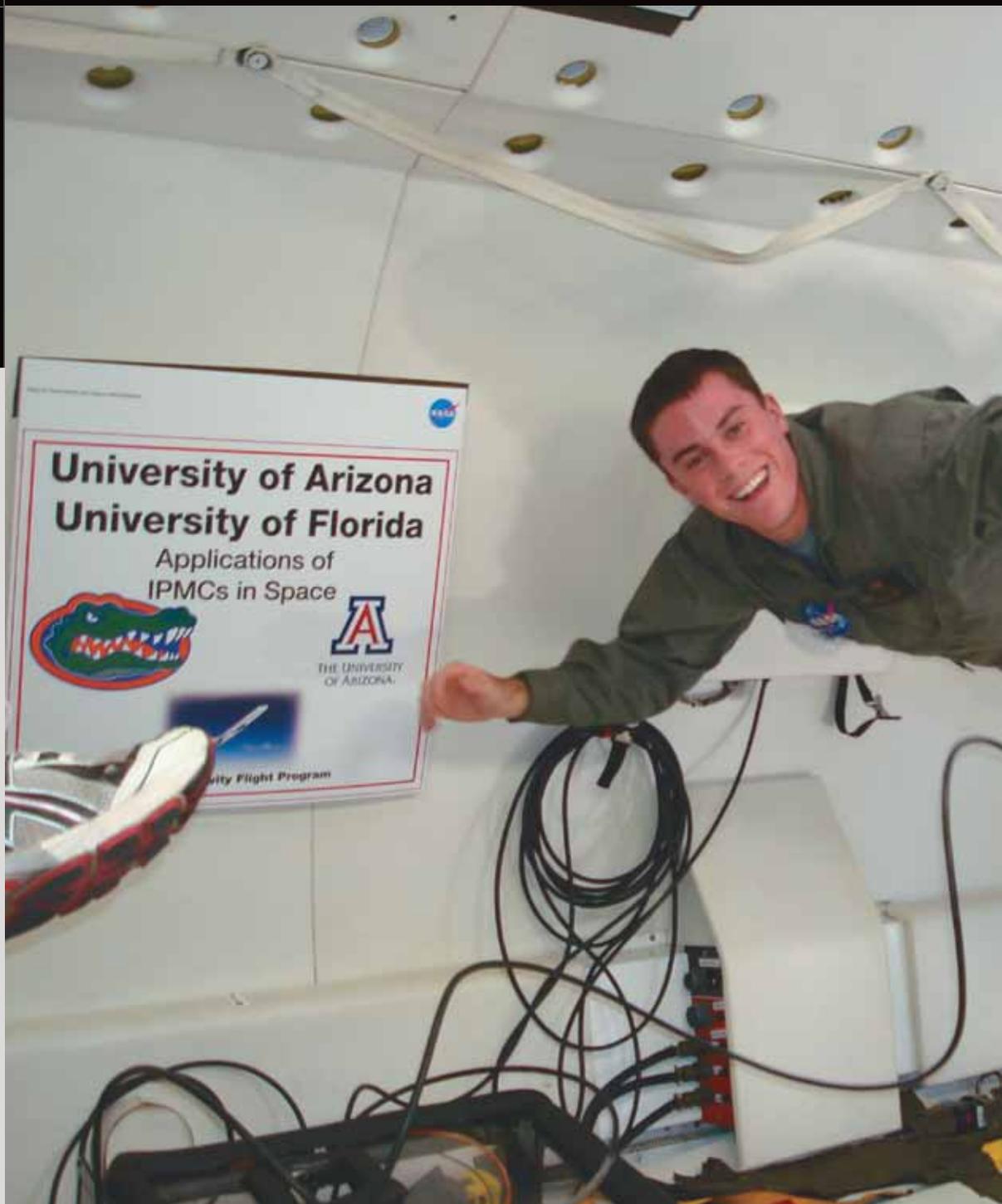
www.mae.ufl.edu

Department of

Mechanical & Aerospace Engineering



The Gator Nation: Destination Space



ON THE COVER: Tony Licari performs research during a zero-gravity period onboard NASA's "Weightless Wonder."

ABOVE: Andrew McDonald adjusts to the zero-gravity environment.



Students Tony Licari and Andrew McDonald, along with three University of Arizona students, participated in NASA's Reduced Gravity Student Flight Opportunities Program. Licari and McDonald worked closely with professor Peter Ifju, to propose, design, and build an experiment researching the deflection characteristics of Ionic Polymer-Metal Composites (IPMC) in varying gravitational fields. IPMC's are lightweight, relatively cheap actuators and sensors with promising uses in space applications. Applying a small voltage to the IPMC causes it to deflect about the central axis. Potential space applications for IPMC are as spacecraft flight-vibration sensors, valves, and as strength-enhancers for spacesuit gloves.

In mid-July Licari and McDonald traveled to Johnson Space Center in Houston, Texas, to perform their experiment onboard NASA's Reduced Gravity aircraft, also known as the "Weightless Wonder". The flight consisted of 32 parabolic maneuvers over the Gulf of Mexico where they experienced zero-gravity, lunar-gravity, martian-gravity, and 2-G periods.

MAE Alumnus and NASA Mission Specialist Ronald Garan



Garan (MSAE '96) flew on the most recent space shuttle mission STS-124. Garan was a REEF student under the advisement of professor J. Ed Milton. In his preflight interview Garan says he was inspired as a child to become an astronaut by watching the first moon landing, and again as a sophomore in college when he watched the STS-1 mission.

The primary goal of the STS-124 mission was to deliver, install and activate the Japanese laboratory onboard the International Space Station. In addition Garan and crew performed maintenance and activated the Japanese robotic arm. An extensive preflight interview of Garan can be found on NASA's Web site:

www.nasa.gov/mission_pages/shuttle/shuttlemissions/sts124/interview_garan.html



Garan participates in the mission's second scheduled session of extravehicular activity as construction and maintenance continue on the International Space Station. During the seven-hour, 11-minute spacewalk, Garan and astronaut Mike Fossum (out of frame), mission specialist, installed television cameras on the front and rear of the Kibo Japanese Pressurized Module to assist Kibo robotic arm operations, removed thermal covers from the Kibo robotic arm, prepared an upper JPM docking port for flight day seven's attachment of the Kibo logistics module, readied a spare nitrogen tank assembly for its installation during the third spacewalk, retrieved a failed television camera from the Port 1 truss, and inspected the port Solar Alpha Rotary Joint.

Clockwise:
Professor Carl Crane at the
signing ceremony.

Professor John Schueller:
Proudly wearing orange and
blue.



Professor Carl Crane traveled to Korea to attend a signing ceremony that will allow students from Kookmin University to come to UF in summer '09 for a special class.

Professor S.A. Sherif, director of the Wayne K. and Lyla L. Masur HVAC Laboratory, was the keynote speaker at both the Fourth International Conference on Energy Research and Development, Kuwait City, Kuwait, Nov. 17-19, and the First Egypt-Japan University of Science and Technology Symposium on E-JUST, Alexandria, Egypt, Nov. 25-27. Sherif was also the Technical Conference Chair for the 2008 ASME Summer Heat Transfer Conference held in Jacksonville, Fla., Aug. 10-14. On the day preceding the ASME conference, he and Dr. W.E. Lear successfully organized a workshop with Mississippi State University and North Carolina State University on the Role of Combined Cooling, Heating and Power in Florida's Energy Future.

Professor Tony Schmitz, director of the Machine Tool Research Center, has recently been named to the Board of Directors for the American Society for Precision Engineering (www.aspe.net).

Professor Scott Banks gave a keynote lecture and two invited lectures at the annual meeting of the International Society for Technology in Arthroplasty in Seoul, Korea. Banks also accepted a three-year term serving on the Board of Directors for ISTA.



Professor John Schueller visits Itaipu (the world's largest hydroelectric plant) on the Brazil - Paraguay border.

In a meeting in nearby Iguazu, Prof. Schueller was elected Chair of Section III (Equipment Engineering for Plant Production) of the International Commission of Agricultural Engineering.

Professor Anil Rao, his graduate students, and his former students and colleagues introduced a new MATLAB® open-source software for solving optimal control problems. This new software is called GPOCS (Gauss Pseudospectral Optimal Control Software). The software is available for public download from www.sourceforge.net and the main Web site for the code is given at gpops.sourceforge.net. Users who are interested in the code can contact one of the project administrators at gpops.sourceforge.net for more information.

New Books

Two new books by MAE Faculty are out this fall. Both books are based on information taught in undergraduate and graduate classes offered annually in the department.

INTRODUCTION TO FINITE ELEMENT ANALYSIS AND DESIGN by Nam-Ho Kim and Bhavani V. Sankar. Available at: <http://www.wiley.com/WileyCDA/WileyTitle/productCd-047012539X.html>

MACHINING DYNAMICS: FREQUENCY RESPONSE TO IMPROVED PRODUCTIVITY by Tony L. Schmitz and Scott K. Smith. Available at: <http://www.springer.com/engineering/production+eng/book/978-0-387-09644-5>



The University of Florida's booth at the International Machine Tool Show in Chicago this September was staffed by Machine Tool Research Center faculty Tony Schmitz (pictured), John Schueller, Hitomi Yamaguchi Greenslet, and Curtis Taylor. The central location of the booth allowed it to be seen by most of the more than 90,000 attendees.

New Faculty

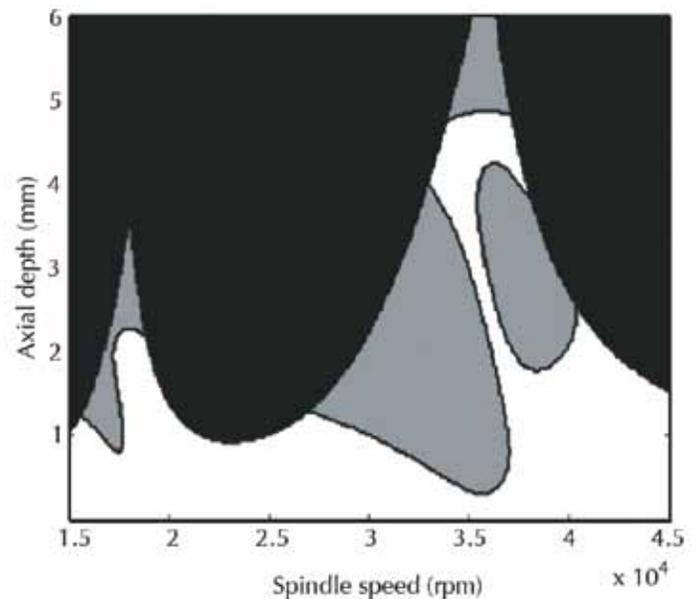
Prabir Barooah received his B.Tech ('96) from the Indian Institute of Technology, Kanpur, his MSME ('99) from the University of Delaware, Newark, and his Ph.D. in Electrical and Computer Engineering ('07) from the University of California, Santa Barbara. Before starting his graduate work, he worked at the United Technologies Research Center, East Hartford, Conn. Barooah received a NASA group achievement award ('03) and the best paper award at the Second International Conference on Intelligent Sensing and Information Processing ('05). His research interests include distributed control and estimation in large-scale networked systems. Barooah joins the faculty as an assistant professor. He can be reached at pbarooah@ufl.edu.

Curtis Taylor received his BSME ('98) from the University of Maryland, College Park, and his MSME ('02) and Ph.D. ('05) from the University of Arkansas, Fayetteville. Before starting his graduate work in 2000, he worked for one year as a software development project manager at Capital One Financial Corporation in Richmond, Virginia. Taylor has also held internship and research appointments at the Central Intelligence Agency, United Technologies Corporation, the National Center for Electron Microscopy at Lawrence Berkeley National Lab, and the Virginia Commonwealth University. He is a recipient of the National Science Foundation IGERT Fellowship, the University of Arkansas Doctoral Fellowship, and United States Air Force Research Faculty Fellowship. His research interests include nanoscale manufacturing, nanomechanics and nanomaterials. Taylor joins the faculty as an assistant professor. He can be reached via e-mail at curtis.taylor@ufl.edu.

Hyo Soo Kim, a doctoral student and Alumni Fellow studying under professor Tony Schmitz, has recently been recognized with two awards. First, he won a silver medal and a \$3,000 cash prize in the 2008 Samsung Electro-Mechanics 4th 'Inside Edge' International Thesis Competition. Samsung flew Kim to Korea in late October to present his paper and compete for the top award. Kim's topic, "A new heterodyne interferometer with zero periodic error and tunable beat frequency," was featured in the "Current Research" section of the MAE Spring 2008 newsletter. Second, Kim was awarded a 2008 Student Scholarship for the annual American Society for Precision Engineering conference (held in Portland, Ore. from Oct. 20-24). This award included a \$1,000 cash prize, conference registration, free tutorials, and recognition at the annual meeting. It is given to graduate students who show the most promise to contribute to the field of precision engineering. Kim presented his paper at the conference.

The Society for Green Mobility is a new student organization in MAE. Together with the American Solar Energy Society and the Society for Sustainable Engineering, they plan to compete in the 2010 American Solar Challenge, which is a national level solar car race. Other competitors have included Stanford and MIT, and many teams go on to race in the World Solar Challenge in Australia. Members of the Society for Green Mobility also work at UF's biodiesel plant. For more information contact Thomas McGilvray, President, at (321) 543-5268.

Raúl Zapata, a doctoral student for professor Tony Schmitz, presented a paper entitled "The milling dynamics super diagram: Combining stability and surface location error" at the annual American Society for Precision Engineering conference in Portland, Ore. Oct. 20-24. Co-authors are Schmitz and MAE undergraduate Christopher DeMarco. In the paper, Zapata augments the well-known milling stability diagram with the user selected maximum allowable surface location error (caused by forced vibrations during milling) to produce a new "super diagram" which identifies stable zones that also meet accuracy requirements. An example is shown in the figure. Here, the unstable zone is black. This represents combinations of axial depth of cut and spindle speed that would yield chatter (self-excited vibrations). The stable zone is divided into two sections: those that meet the pre-selected accuracy requirements (white); and those that do not (gray). By making this information available at the process planning stage, manufacturers can increase milling productivity and reduce cost.



The solar-powered biodiesel plant at UF is a massive project involving volunteers from many student groups in the College of Engineering, including the American Solar Energy Society, American Society of Mechanical Engineers, the Society of Green Mobility, the Society of Women Engineers and the National Society of Black Engineers. At the plant, reclaimed frying oil from the Reitz Union, Gator Corner and Broward dining centers, and any other Aramark dining location, is converted into biodiesel fuel. Prof. Skip Ingley oversees solar panel and solar water heater designs. Senior MAE student Eric Layton oversees solar panel designs and energy consumption at the plant as part of a technical elective he is completing with Ingley. Professor Pratap Pulummanappallil, UF Department of Agricultural and Biological Engineering, oversees the plant. Doug Renk, a graduate student in Agricultural Operations Management assists. Layton says the facility is capable of producing close to 500 gallons a month of biodiesel fuel. The primary client is UF's physical plant, which uses the biodiesel fuel to create a "B20 Blend," a mixture of 20 percent biodiesel with 80 percent normal diesel fuel. Currently there are approximately 40 photovoltaic panels to be installed to completely power the plant. The installation is set to be completed in January. For more information, contact Eric Layton, garf2003@ufl.edu.

The Society of Automotive Engineers is currently working on its 2009 season Formula car. The interdisciplinary team spent the summer optimizing the suspension geometry for the new tire compound, testing traction control settings, continuing driver development, and participating in some fun driving for the sponsors and team members. The summer's testing provided great information to aid in the design of the new car. The team is currently working on frame construction and finalizing design of all the systems on the car. They are hoping with this year's aggressive build schedule they will be able to finish the car in December, and spend the remaining five months performing tests until the competition. The extra time spent testing will hopefully give the team the extra edge it need to place even higher than the 2008 9th place international finish.

The group also recently hosted a Gator Trax session for Tau Beta Pi. This was an opportunity for 60 elementary and middle school students to tour these facilities, learn about the Baja and Formula car projects and gain exposure to hands-on engineering. Students were placed in groups and given SAE Foundation's "A World in Motion" electric vehicle component kits. Volunteers

explained the relationship between torque, applied power, and how to select the proper size and location of gears to meet certain goals. Gator Motorsports Vice President Ashley Averill gave an interactive lecture on gear ratios to the students before they got to apply the knowledge they gained hands on. The goal of this program was to promote SAE International's goal of fostering an interest in science and engineering at a young age.

The Small Satellite Design Club, under the direction of professor Norman Fitz-Coy, participated in the 4th annual Florida University Satellite Design Competition. The competition was held in Gainesville and brought together students from across the state to present their designs for innovative satellite concepts. The UF CubeSat team received the first place grand prize of \$7,500 to begin building their SwampSat mission. SwampSat is a revolutionary concept aimed at introducing cost-saving initiatives to establish small satellites as a practical alternative to the larger satellites produced today. Targeted for a 2009 launch, SwampSat will demonstrate a compact attitude controller for precision pointing and rapid retargeting that could eventually be a black-boxed subsystem component. With the success of this concept, UF research will continue to pave the way for small satellites to have a future both in and out of our world. The SSDC team is supported by the newly formed NSF center, the Advanced Space Technology Research and Engineering Center, in the New Engineering Building. Students have access to extensive resources including top-notch faculty and state-of-the-art laboratories. For more information, please visit SSDC on the Web at www.ufsmallsat.com or in person at the SwampSat mission headquarters in NEB 150.

The annual Gainesville Solar Tour took place on Oct. 18. The Solar Energy Society at UF puts on the event in conjunction with the national organization. It is billed as the largest solar event in the United States. Attendees had the opportunity to talk to local solar installers, such as Pure Energy Solar and ECS Solar, in addition to other sustainable companies at UF's Energy research park. Also on display were alternative modes of transportation ranging from solar-powered tricycles to electric cars. A tour of a local biodiesel production plant was offered as well as maps that directed participants on self-guided tours of local homes and businesses implementing solar energy including the largest commercial system in the city and a zero-energy home.



A, B & C — UF's Biodiesel Plant and solar panels.

D — Middle school students tour the facilities to learn about the Baja and Formula car projects.

E — Members of SAE work on Formula car components.

F — A solar-powered tricycle.

G — Small satellite Design Club receives first prize at the FUNSAT competition.

Alumni News

Allen J. Richardson (B.S. ME '56) appeared in the NOVA documentary, "Space Shuttle Disaster," on Oct. 14 on PBS. He is also a leader in establishing the Shuttle Advocacy Team, which aims to save the shuttle program. There is a companion article to the Nova television program entitled, "A Case for Saving the Space Shuttle," at <http://www.pbs.org/wgbh/nova/columbia/richardson.html>.

Jameel Khan (Ph.D. '06) was selected by the ASME Journal of Heat Transfer Editorial Board as a Best Reviewer for this year. He received his award at the International Mechanical Engineering Congress and Exposition in Boston, Mass., Oct. 31 - Nov. 6. Khan is presently serving as a Thermal Performance Engineer at GE Energy.

Scott Zeeb (B.S. ME '98, M.S. ME '00) is a team leader on one of nine teams in the X PRIZE Foundation/Northrop Grumman \$2 million Lunar Landing Challenge on Oct 24 & 25. He is working for Design Integrity in Chicago.

David L. Burris (B.S. '03, M.S. '06, Ph.D. '07) received the ASME's Marshall B. Peterson Award for Early Career Achievement in Tribology. Burris was honored for his notable contributions to polymer nanocomposites, polymer tribology, and measurement uncertainties in friction and wear; and for the development of novel in situ tribometers. Burris is an assistant professor at the University of Delaware.

Alumni Updates



Jim Humbert B.S. ME '03, after graduating, Humbert took an internship in the logistics department with the Department of Defense. He relocated to the Washington, D.C., area where he worked on various logistics and engineering projects for the H-60, C-40A, T-700, V-22, TC-12, T-44, and EA-6B programs. Humbert developed a users guide for the Department of Defense to implement Unique Identification for tracking and asset visibility purposes. As an intern, Humbert was able to participate in a few very exciting activities! He landed on a nuclear aircraft carrier in the middle of the Atlantic Ocean and spent three days out there, trained with H-60 pilots on POW evasion, and fired an M-16. After graduating from the intern program, Humbert took a position in Jacksonville, Fla. as a logistics management specialist and Reliability-Centered Maintenance (RCM) Engineer. In May '04 Humbert married fellow Gator alum Erica Libbey (BSN '03) and recently had their first "future Gator" Christian Robert. Humbert works with five other former Gators, including Don Triest (BSME. '82). Caption: Jim Humbert and wife Erica Humbert at the UF-USC game in 2006.

John A. Devore B.S. AE '70, Devore started his engineering career at the Naval Air Rework Facility in Pensacola, Fla. as a Maintenance Engineer working problems that arose with the Pratt & Whitney J60 and the General Electric J85 turbojet engines that were used in the North American T-2B and T-2C basic jet trainers in the naval air training fleet. In the fall of 1973 he began working for Pratt & Whitney at their High Mach Number and High Altitude test facility located at the Florida Research and Development Center in West Palm Beach, Fla. There Devore was a Test Operations Engineer working test stand set-up and developing operating procedures for development testing of the F100 engine that powers the F-15 Eagle and the F-16 Falcon. He also did development work on the TF30 engines that powered the General Dynamics F-111 and the F-14 Tomcat. Advanced engine components were also tested as part of the Advanced Technology Engine Gas Generator program, which developed, advanced compressor airfoils, advanced combustor components and advanced turbine airfoils that eventually made their way into production engines after extensive test and evaluation. After 12 years in the test area Devore transferred into the Advanced Technology Engine Gas Generator/Integrated High Performance Turbine Engine Technologies engineering group. There he worked on the design, fabrication, instrumentation, assembly and testing of advanced turbine components which evaluated new materials, advanced cooling techniques and improvements in turbine durability and efficiency. Some of these advances are now incorporated in the F119 engine that powers the F-22 Raptor and the F135 engine which powers the F-35 Lightning II Joint Strike Fighter. Devore says his career was very rewarding and he is enjoying his retirement. He says, "Being part of the Gator Nation fills me with a great sense of pride when I return to the University of Florida campus. I am forever grateful for the friendships made and the education I received there."

In the Classroom

with Professor Scott Banks



80 Students carrying calipers and knives in the classroom? Who said engineering wasn't exciting? Pictured here are senior capstone design students just before their first exam of the fall semester. They are holding up calipers and pen knives in anticipation of having to disassemble and reverse engineer a mystery object for their exam. Professor Banks and Professor Peter Ifju are team-teaching the course.

Test Your Knowledge

Exam problem from EML 4321 Manufacturing Engineering

In a container making operation, the length of the sides of the cubic container are 200 mm. If the uncertainty in the side length is 0.5 mm, determine the uncertainty in the container volume (in mm³).

Answer:

If we let s be the side length, then we can write the volume as $V = s^3$. We use the law of propagation of uncertainty to determine the combined standard uncertainty in the volume, $u_c(V)$. See Eq. 1, where $u(s)$ is the standard uncertainty in the side length.

(1)

$$u_c(V)^2 = \left(\frac{\partial V}{\partial s}\right)^2 u(s)^2 = (3s^2)^2 u(s)^2$$

Substitution gives $u_c(V) = 6 \times 10^4$ mm³. For a container volume of 800×10^4 mm³, this represents a 0.75% uncertainty. Note that the side length uncertainty percentage is 0.25%.

For more information, you may download a PDF copy of NIST Technical Note 1297 "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results" from: <http://physics.nist.gov/Pubs/guidelines/TN1297/tn1297s.pdf>.

Current Research

Profs. B.J. Fregly and Scott Banks were recently awarded NSF funding for a project entitled "Computational Simulation of Knee Osteoarthritis Development." The project is being performed in collaboration with researchers at Scripps Clinic and the University of California at San Diego in La Jolla.

When someone tears a ligament in the knee (for example, the notorious anterior cruciate ligament (ACL)), they are likely to develop osteoarthritis in that knee over the next decade (recall that osteoarthritis is simply the wearing away of the cartilage surfaces that line the ends of our bones, resulting in significant pain and loss of function). It is known that the motions and loads in an ACL-deficient knee are different from those in a normal knee, but it is not known why or how these motion and load changes lead to the development of osteoarthritis.

This project will develop computational simulations (one of NSF's new priority areas) of ACL-deficient knees

using a patient's healthy knee as the starting point. Once the healthy knee computer model is constructed, experimental measurements of the motions and loads from the ACL-deficient knee will be applied to it, and a cartilage adaptation law will be used to alter the thickness of the cartilage gradually over a sequence of simulations. If Fregly's and Banks' simulations are able to transform the cartilage surfaces in a healthy knee computational model into the surfaces of an osteoarthritis knee, they will have a basis for using the model to develop new surgical or rehabilitation treatments that can hopefully alter the course of the disease.

These concepts are derived from previous collaborations between Fregly, Banks and Prof. Greg Sawyer, where computational simulations were developed to predict how millions of motion and loading cycles produce wear in total knee replacements. That work was funded by NSF as well.



B.J. Fregly works on a cadaver knee wear experiment to simulate the arthritis process at Scripps Clinic in La Jolla, CA. This work is the first step toward the human subject simulations that will be performed in the current research project.

Alumni and Awards Weekend

The 2008 MAE Annual Awards Dinner was held April 11, 2008, at the Hilton University of Florida Conference Center. The evening included a one-hour new building kick-off reception, followed by a banquet and awards ceremony. Faculty, student and staff awards were given out, and six outstanding alumnus were honored. Staff awards were given to Teresa Mathia, David Rockey and Mark Riedy for their many years of excellent service at UF. **The online nomination form for the 2009 Outstanding Alumni Awards can be found on the MAE homepage. The deadline for nomination is Jan. 31. Please check www.mae.ufl.edu/mae-oaa for additional information.**



Mark Riedy receives the Staff Service award from MAE Chair S. Balachandar



Outstanding Alumni Knox Millsaps, Juan Santiago, Joaquin Castro, Fareed Ossi, and Craig Young.



Teacher of the Year Anil Rao receives his award from S. Balachandar. Also pictured: Jan Rocky.



Teresa Mathia receives the Staff Service Award from S. Balachandar.



Proud MAE students display their awards

Talk Back

Please complete our alumni update card so that your information can be included in future newsletters. You can also e-mail recent updates to the newsletter editor at mae-newsletter@ufl.edu. Go Gators!

FULL NAME (INCLUDING MAIDEN NAME)

ADDRESS

CITY

STATE

ZIP

PHONE (AREA CODE)

E-MAIL ADDRESS

YEAR OF GRADUATION

DEGREE

MAJOR

NEWS OF INTEREST ABOUT YOUR ACTIVITIES, RECOGNITIONS, ETC.

JOB TITLE

EMPLOYER

BUSINESS ADDRESS

MAE DEPARTMENT NEWSLETTER
231 MAE-A
P.O. Box 116250
Gainesville, FL 32611-6250

mae-newsletter@ufl.edu

New Building Campaign

The College of Engineering Development Office has announced a number of major contributions toward the new Mechanical & Aerospace Engineering building, each resulting in a naming opportunity for the donors. They are:

William W. & Eloise Gay Lecture Room (\$250,000)

Gary J. Miller Ph.D. Orthopedic Biomechanics Laboratory (\$100,000)
(Given by Suzy and Gary J. Miller Ph.D.)

William J. Bierbower, Jr. Design & CAD CAM Laboratory (\$50,000)

Frank C. & Jane C. Gillette Design & Rapid Prototyping Laboratory (\$50,000)

Thomas O. Neff Fabrication Methods & Application Laboratory (\$50,000)
(Named in memory of Professor Neff by Hjalma and Laura Johnson)

Charles D. & Peggy H. Myers Advisor Office (\$10,000)

Curtis H. Stanton Advisor Office (\$10,000)

All gifts to the new building are eligible for dollar for dollar matching from the state of Florida Courtelis matching gift program. More details on the new building and on how you can help are coming your way soon. For more information, please contact Rebecca M. Hoover, Director of Development at 352-392-6795 or bhoov@eng.ufl.edu.

Acknowledgements

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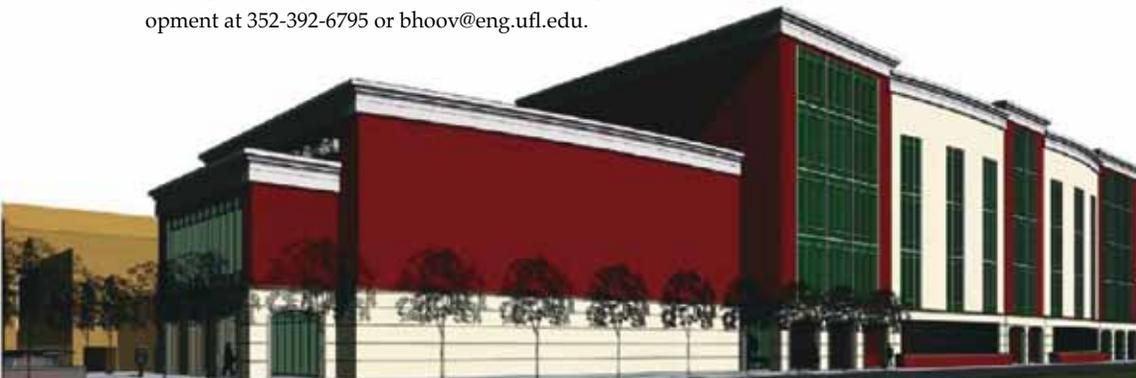
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Our Department will celebrate its 100th anniversary throughout 2009 and into 2010. Watch our Web site for more information in the coming months. If you have a story to share about your time here and the professors and/or staff who influenced your life the most, send it to Dr. Gene Hemp, the coordinator for the anniversary celebration, at ghemp@ufl.edu.

