Professor Sara Roccabianca joined the ME faculty this fall, and she is investigating cancer cell growth in the Soft Tissue Mechanics Laboratory. Read all about it on pages 8-9!
Building Pyramids

by Professor Ron Averill,
ME Associate Chair

One of my favorite stories is about a traveler walking the streets of ancient Egypt. He sees a man mixing together straw and mud, and he approaches the worker to ask him, “What are you doing?” The worker seems a bit aggravated as he points to a pile of bricks nearby and responds, “Can’t you see, I’m making bricks!” The traveler continues down the road, and soon he passes another worker mixing together straw and mud. Again he asks, “What are you doing?” The second worker points to the skyline behind him and says, “Can’t you see, I’m building a pyramid!”

I don’t know the origin of this story, but it’s one of my favorites because it reminds me that what we think about while we work greatly affects what we do, how we do it, and the end results.

For example, the first worker is probably trying to meet his daily quota of bricks so that he can go home and relax. He might be thinking about what’s for dinner tonight, or some other unrelated topic. On the other hand, the second worker is focused on building a pyramid. As he combines the straw and mud, he might be thinking that this very brick could be placed in a critical location in the pyramid, so it needs to have just the right combination of straw and mud. The strands of straw should be oriented properly, and the mud should be compacted really well to remove voids that could spawn cracks. The integrity of the pyramid could depend on this brick. Which brick maker would you rather buy your bricks from?

“WHAT ARE YOU DOING?”

Like the traveler in the story, when I walk around campus I often ask students, “what are you doing?” I usually get answers like: “Can’t you see, I’m studying for my thermo exam!” or “Can’t you see, I’m trying to finish a dynamics homework assignment that’s due tomorrow!”

I never hear answers like: “I’m trying to become a great engineer, so I can develop innovative technologies that serve mankind!” or “I’m trying to become a great doctor, so I can ease suffering and save lives!”

Whatever your end goals are, you should be thinking about them while you are doing the work to achieve them. You must plan and do your work with your goals in mind. Otherwise, it’s too easy to get into the mode of just making bricks, when what you really want to do is build a pyramid.

I fear that many students do not have their end goals in mind while they do their school “work.” For example, often the purpose of doing homework is to “get it done,” not to develop critical skills that will help to make them a great engineer. The goal of studying is to pass a test, not to achieve a deeper understanding of core engineering principles upon which future innovations will be based.

Cont’d on pg 14

Academic Advising

1) ME Juniors and Seniors are advised by Gaile Griffo. For an appointment, call 355-3338, or go to 2560 EB.
2) Sophomores with a 3.0 GPA who will be juniors at the end of this semester are advised by Gaile Griffo. For an appointment, call 355-3338, or go to 2560 EB.
3) Sophomores who do not fit the criteria in number 2 above are advised by Colleen McDonough. To schedule an appointment with her, call 355-6616 x 2.
4) ME Freshmen are advised in W-8 Wilson Hall on a walk-in basis only.
Congratulations to all mechanical engineering December graduates! On behalf of the ME faculty, I wish you the greatest happiness and success in your careers, graduate studies, and personal lives. The following students had applied for graduation by October 10. If your name is missing, please contact me immediately (Email Gaile at <griffore@egr.msu.edu> Tele: 517-355-3338).

Joseph Emanuel Aljajawi
Vito Alessio Balsamo
Darius Deloren Barrett
Samuel Alain Bekkers
Scott William Belonge
Joshua James Boerger
Christopher Lee Brady
Elizabeth Ashley Brandon
Nicholas Brandon Chase
Florian Cherdron
Craig Evan Cline
Brett Michael Close
Gabrielle Chelsea Colby
Juntai He
Steven Charles Hilliard
Bianna Mychal Hogan
Robert Lee Hyatt
Robert Jay Jakubowski
Steven Francis Jurewicz
Carl John Kaspari
Anthony Barnett Kazenko
Brandon Michael Keener
Adam Stephen Kluz
Frank Martin Kmet
Danielle M LaPointe
Theodore Frederick Linabury
Cody Michael Little
Steven Michael Cooper
Franklin Kenneth Luchini
Lauren Elizabeth Marino
John Nelson Muller
Casey Kwame Nicholson
Scott Patrick Oldham
Thomas David Parshall
Shenli Pei
Paul Edward Petrous
Michael Casey Ray
Benjamin Asa Rittinger
Daniel Adam Schwartz
Jason Ronald Seely
Jamie Katherine Steinberger
Seiun Lom Teshome
David Torres Jr
Jason James Wagnitz
Charles Clark Whiteside
Alexander Limonov Williams
Kyle Patrick Wright

Dean’s List

Congratulations to these 303 ME majors who made the Dean’s List after Spring and Summer 2014. To be on the Dean’s List, you must have a semester GPA of 3.5 or better. This list is from September 19. For updates, go to: http://www.reg.msu.edu/ROInfo/GradHonor/DeansList.aspx


Tutoring

• The ME Learning Center, located in 1239 EB, has mentors for ME 201, 222, and 361. The hours for Fall 2014 are:
  Sunday 6-10 p.m.
  Monday 1-5 p.m.
  Tuesday 2-10 p.m.
  Wednesday 2-10 p.m.
  Thursday 2-10 p.m.
  Friday and Saturday-Closed

• The Guided Learning Center (GLC), located in 1108 EB, offers free drop in tutoring, aimed at the most common core engineering courses (MTH 116, 132, 133, 234, 235; PHY 183 & 184; and CSE 231). Their website can be found at: http://www.egr.msu.edu/core/residential/tutoring

• ME graduate student and Pi Tau Sigma undergraduate tutors can be contacted through the ME Advising Office. These tutors charge a fee, which you can negotiate with them. If you are interested, email Gaile Griffore at griffore@egr.msu.edu

http://www.surveymonkey.com/s/3L7XFL8 (Deadline: Nov 14)
Professor Bush Receives the 2014 Withrow Award!

Professor Tamara Reid Bush received the 2014 Withrow Teaching Excellence Award last spring at a special awards luncheon and ceremony. She was presented with an inscribed plaque, a medallion, and a small stipend. Each year a committee consisting of student representatives from ASME and Pi Tau Sigma reviews nominations from ME juniors and seniors and makes the selection.

Tamara Reid Bush, an assistant professor in the Department of Mechanical Engineering who directs the Biomechanical Design Research Laboratory, is often described by her students as a professor who really cares. Whether it is because of her work in the classroom, in her office, or in the halls of the Engineering Building, praise from the students is clear: “She puts her students first, which is what makes her and MSU so great;” “Dr. Bush is a well-rounded professor who realizes the importance of helping out in the community;” “She is an inspirational professor, as she truly loves her job and that is reflected in everything she touches.”

Dr. Bush is creative and innovative, but also demanding in the classroom, and engaging and supportive outside the classroom. She remembers the name of every student in her class. Her biomechanical design course is a favorite among students and gives them a very special perspective on product development, that is unique in our program. She is an outstanding instructor.

Dr. Bush’s research area is translational biomechanics. Her overall research goal is to use engineering approaches to better understand the human body for the purpose of improving quality of life. She is particularly interested in injuries and other issues experienced by people with disabilities. In terms of extra-curricular activities, she enjoys all types of water sports including swimming, water-skiing, and wind-surfing. She also enjoys hiking with her family and photography.

ME Ph.D. Student Wins Prize!

Christopher Cater, ME Ph.D. student, won the first prize of $1000 in the 2014 American Society For Composites (ASC) Student Simulation Challenge. The prize was presented at the 29th Annual Technical Conference held at September 8-10, 2014 at the University of California, San Diego (UCSD). The subject of this year’s challenge was progressive damage modeling in composite structures, and the problem involved a composite structure joined by four rivets in a double leg configuration. Out of the ten teams that participated, seven managed to complete the competition. Cater scored 95/100 and took the first place. Indeed, he won by a big margin (second place was 82/100). His Ph.D. advisor is Professor Xinran Xiao.

The 30th ASC Annual Technical Conference will take place at Michigan State University on Sept 28-30, 2015. It will be chaired by three ME professors: Xinran Xiao, Alfred Loos and Dahsin Liu. The conference website can be found at http://wwwdev.egr.msu.edu/asc2015/
Department News

• **Professor Lik Chuan Lee** has joined the ME department as an assistant professor. Dr. Lee completed his Ph.D. studies at the University of California, Berkeley, and then worked as a postdoctoral scholar in the Department of Surgery at University of California, San Francisco. His research is in the area of computational mechanics with a current research focus in computational cardiac modeling. Dr. Lee and his wife, Didiana, have two sons, Darren (age 3) and Shawn (age 1). He enjoys watching and playing basketball, as well as travelling.

• **Professor R Rajiv Ranganathan** is an assistant professor in the Department of Kinesiology with a joint appointment in Mechanical Engineering. His research interests are in motor learning and biomechanics. He is particularly interested in how humans produce skilled and coordinated movement, and how this ability is altered in the context of development, aging, and movement disorders. He is an avid reader of popular science books and is passionate about improving the dissemination of science to the public, especially school children. Dr. Ranganathan’s wife, Mei-Hua Lee, is also an assistant professor in the Department of Kinesiology.

• **Professor Sara Roccabianca** has joined the ME department as an assistant professor. She received her Ph.D. from Trento University in Italy where she developed a semi-analytical solution for the finite bending of multilayered rectangular plates. As a postdoctoral student at Yale University, she developed a comparative study on the mechanics of human aorta investigating the correlation between the mechanical behavior of the aortic wall and both the position along the aortic tree and age of the subject. Dr. Roccabianca is an avid movie fan whose favorite directors are Sofia Coppola and Wes Anderson. She also enjoys yoga and music, especially rock and roll. She lives with her husband, Andrea Valerio.

• **Professor Emeritus Robert Hubbard** has been inducted into the Sports Car Club of America Hall of Fame. Dr. Hubbard and Jim Downing, a driver himself and Hubbard’s brother-in-law, developed the Head and Neck Support device (HANS) in the mid-1980s, following the death of a racer friend who died as a result of a skull fracture. Since 1990 more than 200,000 HANS devices have been put into use by drivers. Read more about Dr. Hubbard’s Hall of Fame induction at [http://msutoday.msu.edu/news/2014/msu-inventor-of-racecar-safety-device-honored/](http://msutoday.msu.edu/news/2014/msu-inventor-of-racecar-safety-device-honored/)

• **Professor Xinran (Sharon) Xiao** has been elected a Fellow of the American Society of Mechanical Engineers (ASME).

• **Professor Ranjan Mukherjee** has been appointed as Associate Chair for the Graduate Program.

• **Ms. Jayme Bisard**, undergraduate secretary, left in June to take a position with the Spartan Fund in Spartan Stadium. In her new role she is supporting development officers in their efforts to bring in donations to MSU athletics.

• **Ms. Alaina Burkardt**, our new ME undergraduate secretary, joined the department in August. Her husband is a strength coach for the MSU football team, and they both love MSU football! Alaina enjoys eating and playing with her cat Duffy.

• **Ms. Shirley Wohlfert** has joined the ME department as a secretary. She will be handling duties related to design day. Shirley comes to us from the Composite Materials Structures Center (CMSC) where she worked for 2 1/2 years. She is working part time, Monday-Friday, 9 a.m.-1 p.m.. Shirley has five

Curriculum News

**ME 465 Prerequisite Change:** The prerequisites for ME 465-Computer Aided Optimal Design have been changed to (ME 222 and 280) and (ME 371 or concurrently).

**Co-op Students:** Before you leave for your Spring 2015 co-op rotation, please be sure to discuss your schedule for next Fall 2015 / Spring 2016 with your academic advisor.

**ME 481—ME Design Projects** requires department approval before you can enroll. If you have an accurate long-term schedule on file in the ME Advising Office, request approval by submitting the ME 481 Approval Form: [http://www.egr.msu.edu/me/undergraduate/forms-undergraduate](http://www.egr.msu.edu/me/undergraduate/forms-undergraduate). If you do not have an accurate long-term schedule on file, schedule an appointment with Gaile by calling 355-3338 or stopping by 2560 EB. NOTE: May and August graduates who have completed ME 471 and are at least concurrently enrolled in ME 410, may be eligible to take ME 481 during fall semester. Ask Gaile if you qualify.

**ME 489—Technical Communications** (2 credits) is on the spring schedule. Instructor: Craig Gunn, ME Director of Communications. IMPORTANT: This course is an Other Elective. It is not a Senior Elective.

Cont’d on pg 12
International Development: Humanitarian Engineering by Professor Brian Thompson

ME491/602—Special Topics: Humanitarian Engineering is on the Spring 2015 schedule. It will provide students with a hands-on creativity, innovation, and entrepreneurship opportunity. To request an override, see page 15, override instruction number 2.

W. H. Welch, MD (1850-1934) founder of the School of Public Health at Johns Hopkins University in Baltimore, Maryland, wrote, ‘It is a well-known fact that there are no social, no industrial, no economic problems which are not related to health.’

Motivated by this self-evident truth, why not pause from your traditional, narrow, academic studies on the banks of the Red Cedar River, and contemplate how you could exploit your engineering prowess to enhance the health of under-represented men, women and children living at the margins of life on planet Earth? Why not enroll in an exhilarating class incorporating meaningful semester-long design-build-test-refine risk-taking projects? It’s limited to only 12 students and they will coalesce into project teams that will meet with the instructor each week in addition to receiving formal lectures.

This special topics class will transform you irreversibly by infusing contemporary thinking about product development, creativity, innovation and entrepreneurship in a global context. Moreover, these experiences will enable you to contribute to the public good, not only in the United States, but also in under-developed countries where 80% of the world’s population struggle to survive on an income of only $2.00 each day. Harvard University Professor D.M. Berwick, the former Administrator of the Centers for Medicare and Medicaid Services, wrote that “…sick people tend to be poor, and that poor people tend to be sicker…”

Now before 2050, the world’s population will increase by 50 percent according to the World Health Organization. Let’s reflect on that prediction for a moment. How will planet Earth sustain this huge torrent of hungry people? How can we ensure international peace, equality and justice, as people in this demographic deluge struggle to survive despite the inevitable poverty, trauma and absence of life’s essential ingredients, i.e., potable water, nutritious food, education, sanitation, clean air, employment, shelter, and health? Will this unprecedented global situation precipitate social unrest and mass starvation?

Whatever happens, it’s of paramount importance that the next generation of engineers (yes, that’s YOU!) provides leadership at the vanguard of this international societal struggle for survival. Thus the warp and the weft of intertwined fibers constituting the fabric of this design-intensive course comprise a direct response to the population explosion confronting...
humanity. This fabric is woven from a thread of ideas on humanitarian societal development in third-world countries with a second orthogonal thread of fundamental ideas on the inter-disciplinary problem-solving process that’s relevant to every single nation that shares our small planet.

In ME 491/602, teams will interact directly with foreign advisors overseas, and furthermore, students will receive support to travel to the country where their innovative product will be diffused into that culture. For example, in December 2014 a four-person team will deliver a human-powered pigeonpea threshing frame for preserving mangoes in Kenya; a human-powered treadmill pump for irrigating crops in India; and an energy-efficient device for cooking legumes to enhance the diet in Tanzania.

ME491/602 provides students with meaningful inter-disciplinary opportunities for community engagement beyond the nation’s borders. These opportunities will advance them morally; they will increase their self-confidence in utilizing engineering principles; they will broaden their own personal horizons; and they will transform them into bona fide global citizens. Further buttressing of engineering concepts is provided by a rigorous treatment of the fundamentals of creative problem solving, decision theory, psychological impediments to creativity, and finally the numerous multi-cultural challenges associated with diffusing innovations in sophisticated state-of-the-art organizations here in the United States, and also in parts of the world where people relentlessly struggle to survive long enough to witness the dawn of a new day.

Will you join the throng of international humanitarians by enrolling in ME491/602? Will you? Margaret Meade (1901-1978) wrote, “Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has.” For more information, please contact Professor Thompson at thompson@egr.msu.edu

**ME Study Abroad: RWTH-Aachen, Germany 2015 by Dr. John Foss**

MSU/ME students with a 3.0 GPA or higher have the amazing opportunity to: 1) live in Aachen, Germany (mid-May to end of July 2015), 2) carry out 5 credits independent study plus 4 credits German language study as credits for their MSU degree, and 3) travel in Europe with courses and lab schedules that include 3-day weekends. Also, with thanks to the North American Rockwell Endowment, substantial scholarship funds are available to the students in this program.

The independent study experience gives students the opportunity to participate in a project that meets their interests at the RWTH-Aachen, a premiere European university. Project opportunities include tissue engineering, composite design, fluid flow analysis, automotive topics, plus many more. (It is useful to think of the RWTH as a university on the scale of MIT). The city center – a blend of a historic European city and a vibrant college town – reflects the history of Aachen as one of the Charlemagne capitals (800 AD), and the superb rail system allows our students to easily reach destinations of their choosing. Participants of last year’s program utilized 3-day weekends to travel to Berlin, Heidelberg, Köln, Paris, Amsterdam, Bruges, Barcelona, Milan, Rome, London and more!

Former students are the best sources of information for this program; they can be reached through Prof. J. Foss, Program Director. The 2015 organizational meeting will be held soon after the publication of this issue of the ME Bulletin. Make contact at foss@msu.edu or 355-3337. It is intended that the 2015 group will be formed by the end of Fall 2014.

In the words of a former participant: “Please don’t hesitate to talk to former students! They are more than willing to share experiences and information about the program. This is an opportunity you don’t want to miss.”

**Study Abroad at the University of Edinburgh by Gaile Griffore & Craig Somerton**

Founded in 1582 the University of Edinburgh is one of Europe’s finest universities with a great tradition of producing outstanding scholars, including such giants as Charles Darwin and Sir Arthur Conan Doyle. In engineering, there is William John Macquorn Rankine, who proposed both the Rankine cycle (primary in the operation of steam power plants) and the Rankine temperature scale (the absolute scale used in English units).

The mechanical engineering facilities are very modern, allowing the faculty and students to pursue research topics varying from wave energy to micro-fabrication.

The city of Edinburgh, whose downtown is a short bus ride from the university’s engineering buildings, is listed as a World Heritage Site. In addition, for students seeking leisure activities the city has a terrific night life with many activities for young adults.

You will be able to take courses that fulfill your entire Senior Elective requirement (i.e., 12 credits of Senior Electives, including the 3-credit design intensive course). For more information, contact Gaile Griffore, ME Advisor, 2560 EB, 517-355-3338 (griffore@egr.msu.edu)

**Study Abroad in France (ECAM in Lyon) by Professor André Bénard**

The Department of Mechanical Engineering offers a month-long study abroad program for junior-level students in Lyon, France each summer. The students stay at ECAM, a French engineering school located in the old part of Lyon, for the entire month of June. Students can take the equivalent of ME 201 or ME 410, both taught in English. They also take a French language course (taught in French). If you are interested in this program, please contact Ms. Maggie Blair-Ramsey <blairram@egr.msu.edu> or Professor André Bénard <benard@egr.msu.edu>

http://www.surveymonkey.com/s/9L7XFL8  (Deadline: Nov 14)
Using Mathematics to Understand Cancer Growth
by Dr. Sara Roccabianca

There are three broad categories of experiments that can be done to investigate living organisms and the diseases that can affect them: in vivo, in vitro, and in silico studies. Certainly most of you have heard these terms before, either in the media or in your classes, but how many of you know how these three types of models differ?

Briefly, the term in vitro, Latin for ‘within the glass’, refers to observing the results of a given procedure outside of a living organism. On the other hand, in vivo, Latin for ‘within the living’, describes a more modern technique comprised of experiments using a whole, living organism (i.e. animal studies and human trials). They both have pros and cons. On the con side, in vitro studies are unable to replicate the complex interactions that occur in a living system. However the same complexity can make the results of an in vivo study difficult to interpret. These are some of the reasons why, in the last fifty years, more research has been devoted to the development of theoretical and numerical models that can describe and predict the behavior of biological systems, the so-called in silico studies. These mathematical models of soft biological tissues have already provided important insights into the development of multiple diseases (i.e. hypertension, aneurysms, heart failure, and cancer). Certainly, one can model the complex biology involved in the growth and remodeling of a living system. It is also well accepted that the mechanical environment, meaning applied forces and deformations, has a great influence on soft biological tissue characteristics, both structurally and functionally.

One example of forces leading to remodeling is muscle: we all know that repeated exercise can increase the volume of muscle. What you might not know is that there is a similar relationship between the growth rate of tumor spheroids and the stiffness of their surroundings: the stiffer the surroundings, the higher the compressive forces generated, the slower the tumor grows.

In the Soft Tissue Mechanics Lab, my students and I are interested in understanding the mechanisms that relate the mechanical environment to the biological process of growth associated with melanoma. The development of a solid body tumor, such as melanoma, can be divided in two phases: an early stage, called avascular growth, where the tumor remains in a regular, axisymmetric configuration of a few millimeters in diameter, and a later phase, called vascular evolution, which is a more aggressive stage where invasion and metastasis may take place. In the first stage of growth, cells in the center of the lesion start dying as a result of the deprivation of nutrients and oxygen and turn into a necrotic core, while the cells in the outer three to five cell layers continue to proliferate, Figure 1 (a). From an engineering perspective this can be described as confined growth: the external ring of cells continues growing, compressing the central core. This phenomenon can give rise to an instability of equilibrium and therefore a shape bifurcation, Figure 1 (b, c). It is interesting to recall that asymmetry and border irregularity are two of the five points in the short list of clinical symptoms that can be used for the early recognition of this cancer, the so-called ABCDE (Asymmetry, Border ir-

![Figure 1. (a) Schematic showing the typical organization of solid tumors, such as melanoma, including the external ring of growing cells and the necrotic core. (b) Melanoma lesion showing asymmetry and irregular border. (c) Example of a bifurcation mode caused by a compressive stress state in a non-linear multilayered material.](image-url)
regularity, Color variegation, Diameter and Evolution). The purpose of the research of the Soft Tissue Mechanics Lab is to investigate the effect that the stress field surrounding a growing tumor has on the developmental process of the tumor itself. Specifically, we want to detect and analyze instabilities that might rise from this complex stress state.

Another project that we are interested in is the development of a model of healthy skin and its adaptive remodeling (i.e. pregnancy, weight loss, muscle growing due to exercise). Skin is a thin multilayered membrane that acts as the body’s main barrier, both biologically and mechanically, against the external environment by fulfilling multiple biological purposes (i.e. regulation of heat and water exchange with the surroundings and protection from mechanical, bacterial or viral insults). Its structure can be subdivided into three principal layers: the epidermis, the dermis and the hypodermis, see Figure 2. From an engineering perspective, skin is an orthotropic, highly non-linear material subjected to large deformations. In my lab, my students and I will develop a model able to describe the mechanical behavior of skin by employing the so-called constrained mixture theory. Briefly, every component present in skin, such as collagen, elastin, and cells, will be endowed with different material properties (i.e. the collagen is stiffer than all the rest, the cells have the ability to change their mechanical properties) but they will all be constrained to move together when deformed.

Much remains unknown about the processes of growth and remodeling of tumors and skin. I believe that in silico studies have the potential to help the understanding of the fundamental mechanisms that drive the transition from avascular (dormant) to vascular developmental states for solid tumors (such as melanoma or glioblastoma). In addition, these studies will contribute to significant insight into skin mechanical behavior and the process of growth and remodeling of the healthy tissue.

**Figure 2. Schematic of the layered structure of skin.** The outermost layer (epidermis) is a thin cellular membrane that serves as a barrier but doesn’t provide mechanical resistance; the middle layer (dermis) is mostly composed by a matrix of collagen and elastin fibers and endows strength and compliance to the skin; the innermost layer (hypodermis) serves as a supportive substratum and is primarily made of adipose tissue.
Ankle function in boots is very important in situations where the foot encounters irregular surfaces and/or the wearer is transporting heavy loads such as hiking with varying backpack loads (Figure 1). Ideally a boot that advances ankle function would require (1) levels of medial-lateral ankle support to limit ankle rolling and injury, and (2) appropriate ankle flexibility so that the leg/foot can dorsi-plantar flex to appropriate levels. However, measuring foot/ankle movements within boots and therefore quantifying ankle functional achievement can be challenging.

Information gathered from healthy volunteer studies and cadaver research has been used to create anthropometric test devices for the automobile industry in order to predict injury risk during vehicular crashes. These test devices, or crash test dummies, are usually instrumented to record data on the dynamic behavior of the dummy during a crash. Biofidelic lower extremity surrogates have been developed for sports injury prevention and player safety enhancement. Similar surrogate devices may have broad applicability in the field of shoe design and, once incorporated with 3D ankle properties, could be used to assess ankle function in boots that are exposed to varying loads and rotations. In addition, such surrogate devices may be used in a multitude of tests, decreasing the variation typically generated in tests involving human subjects.

At the Orthopaedic Biomechanics Laboratories (OBL) a project is ongoing that aims at developing a surrogate lower extremity that includes a lower leg and foot/ankle complex. It includes a talocrural joint controlling internal-external rotation and dorsi-plantar flexion, and a subtalar joint controlling inversion-eversion. The 3D rotational stiffness values were adopted from a recently published manuscript (from the OBL) where Dr. Feng Wei and an OBL PhD student, Keith Button, document in vivo 3D dynamic human ankle rotational stiffness. The surrogate ankle has been designed primarily by Mike Klein, a current OBL graduate student. The design goal is to move the ankle in three directions simultaneously under various levels of controlled axial load simulating hiker with backpack loads. With instrumented potentiometers and rotary encoders at each joint, the surrogate ankle will be capable of measuring foot/ankle movements within footwear. An advanced, high-end CAD package (NX 8.0) has been used to design the surrogate ankle assembly. Design prototypes have been 3D printed with an ABS-like plastic material to validate functionality before fabrication (Figure 2). The final ankle is to be machined in T6061 aluminum and high strength steel.

In parallel with the surrogate ankle development, a four-axis (vertical translation plus 3D rotations) servo-hydraulic material’s testing system is being developed in the OBL by Cliff Beckett with help from William Kang. Kang was a recent senior ME student supported by the EnSURE program to work in the OBL. The next goal will be to use the system to validate the surrogate ankle against in vivo rotational stiffness values during simulated gait testing.

The Center for Spartan Engineering
by Kyle Liechty, Co-op/Intern Coordinator

Located in 1340 of the Engineering Building across from Sparty’s, The Center for Spartan Engineering is the ultimate resource for engineers seeking guidance on resumes, interviewing preparation, major career events, and experiential education opportunities. In addition to the everyday consultation activities that take place in The Center, the staff and career peers are active in hosting a variety of career preparation workshops and collaborating with employers for ASK Sessions, mini-Career Fairs, and promotions throughout the school year.

The importance of having quality work experiences while in college is not just a desire for students, but for prospective employers as well. Companies are actively recruiting engineers as early as their freshman year for internship and co-op opportunities, enabling students to gain the essential skills and knowledge needed to obtain a full-time job following college.

While many students are involved in the traditional summer internship, a growing number of employers have expressed interest in hiring Spartans as co-ops. A co-op is traditionally a longer, rotational work experience that allows student engineers to gain a more complete view of the production process, through the design and development of projects over the course of the experiential program. Being lengthier than the summer internship, many students opt to work during the fall or spring semester and balance degree requirements around the work term.

At the Engineering Pre-Gallery Co-op / Intern Exchange, the College of Engineering played host to 70 companies and over 900 students for the 3-hour career event! Seeing growth on student and employer attendance, as well as opportunities available, the Pre-Gallery has solidified itself on the calendars of many engineering recruiters nationwide to attract top-talent, earlier on in the students’ experience.

The Center always has an open door to engineering students and would be happy to provide you with the resources needed to rock that initial employer introduction and get an internship or co-op that offers an in-depth, inside look into an engineering career. Email: careers@egr.msu.edu / Phone: 517-355-5163

You Must Be a Communicator!
by Craig Gunn, Director of Communications

“Taking the Bull by the Horns” used to relate completely to looking at hard jobs and forging ahead to address and conquer whatever stood in front of you. A big project had to be done so you were expected to put your back into it and make sure that not only did it get completed but that it was completed as close to perfection as it could be. It was a good saying to think about because it put you in the right mood to tackle anything that came your way.

With the advent of social media and the constant barrage of information, opinions, lies, and misconceptions hitting you on a continuous basis, it is time to take that old familiar saying and apply it to 2014 and beyond. You are an engineer and people expect that what you present to them will be factual and precise. They don’t want your opinions, your feelings, or your assumptions. They depend on you to present to them in a concise manner those things needed to allow them to live lives of relative safety. In your spoken and written language, you are to be the ultimate professional by always having your communication skills honed to their highest level. You must always consider how you say and write things to be an integral part of your engineering makeup. You will not just graduate as a Mechanical Engineer, you must graduate as a quality communicator OF Mechanical Engineering.

It is time to “Take the Bull by the Horns,” evaluate all the bull that is being thrown, and communicate as a technically competent engineer with an ability to present your knowledge as perfectly as possible. Communication is your life; therefore do the best job you can.
American Society of Mechanical Engineers

The MSU Student Chapter of the American Society of Mechanical Engineers is a non-profit student organization, the main purpose of which is to introduce MSU students to the world of engineering. The Chapter provides a great opportunity for students to meet representatives of leading industrial companies and learn about the companies and possible internship and employment opportunities.

In Fall 2014, ASME will be hosting various informational sessions and bringing in different companies for presentations. The sessions are a great way to meet company representatives and let them learn about you. These interactions with professional engineers, some of whom are MSU alumni, are a great starting point for building your professional network.

These events along with a few social events provide the opportunity to mingle with your fellow engineering students and get involved with them outside of the classroom. The Chapter is also responsible for the organization of various science and engineering oriented events, including some aimed at getting high school students, and even younger kids, involved and excited about engineering. To learn more about our upcoming events please visit

http://www.egr.msu.edu/asme/events.html

Submitted by John Pasko, President.

Pi Tau Sigma

The Tau Epsilon Chapter of Pi Tau Sigma, the international mechanical engineering honor society, has begun the Fall 2014 semester with the hopes of continuing its efforts in bolstering and incentivizing membership within its elite ranks.

Along with the typical initiation processes Pi Tau Sigma members participated in the Tau Beta Pi sponsored “Engineering Futures” event on October 18th and volunteered their services in setting up for the Future Spartan Engineers Preview Day on October 11th. The rest of the semester is full of informational and fun social events.

Students in leadership positions in the Tau Epsilon chapter of Pi Tau Sigma are eager to extend the group’s presence within the engineering college, MSU campus, and greater Lansing community. The goal is to ensure a worthwhile experience within the organization as well as provide members with exclusive benefits and opportunities.

For more information you can visit the Tau Epsilon chapter’s website at http://www.egr.msu.edu/pts/ as well as the national headquarters website at www.pitausigma.org.

Submitted by Grant Ridley, President.

Curriculum News, Cont’d from pg 5

ME 491/001–Intro to Computational Fluid Dynamics (3 credits) will be offered Spring 2015 as a non-design intensive Senior Elective. It will taught along with graduate students who will take the course as ME 840, and who will have different assignments. For more information, see page 15.

ME 491/602–Humanitarian engineering (3 credits) will be offered Spring 2015 as a design intensive Senior Elective. For more information, see page 15.

Class Standing. ME juniors and seniors can obtain this information in 2560 EB. Sophomores should go to W-8 Wilson. Be prepared to show your MSU I.D.

Job Search Advice: The Center is available to answer questions about your job search. To ask a question or schedule an appointment, go to 1340 EB or call 517-355-5163. Or, you can email the office at: careers@egr.msu.edu

Prerequisites: The ME department expects all students, including members of the Honors College, to observe all course prerequisite requirements. If you have a question about prerequisites, contact the ME Advising Office.

The MSU College of Engineering

Design Day

Friday, December 4, 2014
Engineering Bldg

Come and see our students lead, create, and innovate

- Competitions
- Demonstrations
- Presentations
- Awards
SAE Baja

The MSU Baja Racing Team is coming off a successful 2014 season and hopes to continue the progress into this fall and the 2015 Race Season. As we finalize our designs, which we have been working hard on all summer and begin to build, we are also working on getting our new recruits more involved. The team had a successful Rookie Drive Day with about 45 interested students coming out to the track for a day of grilling and driving.

This year the competition season will begin a month earlier, with the first race in the beginning of April, putting more pressure on the team to have a productive build season. With a team goal to finish the car a month before the first competition to allow for proper post-build testing, the team is excited to get the new recruits involved and begin to manufacture our new car.

Anyone interested in joining or learning more about the team should contact Trevor Laskowski (baja@msu.edu), or check out our website (http://www.msubaja.com/). Submitted by Briita Wanhala, Project Manager.

SAE Formula

Every year, students on the Formula SAE Racing team work hard to design, manufacture, and test an open-wheel, formula-style car. Last year, the team took 6th place out of 85 teams at the Formula SAE Lincoln Competition. The team is now working on the 2014-2015 car.

Formula SAE is the world’s largest engineering design competition with over 500 schools competing from around the globe. This year, the team will compete in two events: the first is in May at the Michigan International Speedway and the second is in June at the Lincoln Airpark in Nebraska.

Students on the team gain experience in design, analysis, manufacturing, and testing. The whole car is designed in CAD and all structural components are analyzed using Finite Element Analysis (FEA) software or physical testing. Students also run Computational Fluid Dynamic (CFD) analyses, engine performance simulations, suspension kinematic simulations, composite structure analyses, and more.

The team is always looking for more members and any student at Michigan State University can join! No previous experience is required. If you are interested in joining please contact Nicholas Decker at deckern3@msu.edu. Submitted by Nicholas Decker, Project Manager.

The mud soaked Thomas Dionne and 2014 car, Cerberus, still going strong three hours into the endurance race in Peoria, Illinois.
Building Pyramids, Cont’d from pg 2

based. The goal of writing a design report is to satisfy a rubric, not to learn how to think critically and communicate clearly.

How would your approach to school be different if you gave serious thought to how each activity might affect your career and life goals?

Instead of closing the book and filing away that homework assignment as soon as it’s “done,” you might spend another ten minutes or so to review your approach, to resolve one or more of the problems that you struggled with, or to ponder how the answers might change under a different set of boundary conditions. Instead of just “looking over” your notes to prepare for that midterm exam, you might solve some extra problems to gain confidence in your solution process and do some extra reading to increase your background knowledge of the subject. Instead of submitting that report online as soon as the final word is typed, you might take a short break and then give it one more round of serious editing. Could the organization or structure be improved? Could you have explained that idea more clearly? Is that figure properly labeled and easy to understand? Thinking about your end goals should change how you go about your business.

So, what are you doing?

Dean’s List, Cont’d from pg 3


SUMMER 2014: Zhiheng Cen, Patrick Kelly, Philip Lecznar, Matthew Maier, Heather Raymor, Sean Raymor, Scott Welburn.

IAH/ISS Diversity Requirement

Each IAH and ISS course emphasizes a form of diversity: national diversity (designated “N” at the end of the course title), international and multicultural diversity (designated “I” at the end of the course title), or both (designated “D” at the end of the course title). Students must include at least one “N” course and one “I” course in their Integrative Studies programs. A “D” course may meet either an “N” or an “I” requirement, but not both.

Undergraduate Program Educational Objectives

Department of Mechanical Engineering

Michigan State University

(Approved by the ME Department Faculty on February 17, 2005)

Objective 1: Our graduates will be competent engineers practicing in a diverse range of activities.

Objective 2: Our graduates will use their mechanical engineering education as an impetus for personal & professional growth.

Objective 3: Our graduates will have achieved a noteworthy level of workplace responsibility through understanding their environment and capabilities, including the importance of knowledge management.

Objective 4: Our graduates will be independent thinkers who take ownership in identifying problems and determining effective solution strategies in a timely manner.
SPRING SEMESTER SENIOR ELECTIVES

The asterisk (*) after a course number indicates that it has been officially designated as “Design Intensive.”

ME 417* Design of Alternative Energy Systems. 3(3-0). Prereq: ME 410 or concurrently.
ME 426 Introduction to Composite Materials. 3(3-0). Prereq: ME 222.
ME 442* Turbomachinery. 3(3-0). Prereq: ME 332.
ME 445* Automotive Powertrain Design. 3(3-0). Prereq: ME 444.
ME 464 Intermediate Dynamics. 3(3-0). Prereq: ME 361.
ME 465* Computer Aided Optimal Design. 3(3-0). Prereq: (ME 222 and 280) and (ME 371 or concurrently).
ME 477 Manufacturing Processes. 3(3-0). Prereq: ME 222, MSE 250, and Tier I Writing.
ME 478 Product Development. 3(3-0). Prereq: ME 477 and Tier I Writing.
ME 490 Independent Study. 1-4 credits. See Override Instruction #1 below. You may reenroll for a maximum of 6 credits.
ME 491 Selected Topics in Mechanical Engineering. Section 001: Intro to Computational Fluid Dynamics. See Override Instruction #2 Below. Course Description: Theory and application of finite difference and finite volume methods to selected fluid mechanics and heat transfer models including a potential flow model, a compressible flow model and an incompressible Navier-Stokes model. Prereq: ME 410. This course will be taught with graduate students who will take the course as ME 840, and who will have different assignments. If you have questions, contact the instructor.
ME 491* Selected Topics in Mechanical Engineering. Section 602: Humanitarian Engineering: Design, Build, Test, Communicate, International Projects. See Override Instruction #2 Below. Course Description: Extensive class notes plus web-based material, and a major project requiring students to apply human-centered design methodologies to create and manufacture a sustainable solution to an authentic inter-disciplinary engineering problem in India, Guatemala, or Kenya, or elsewhere, involving people fending for themselves at the margins of life. Prereq: (ME 371) and (Senior-level standing).
ME 495 Tissue Mechanics. 3(3-0). Prereq: ME 222. Biomechanical Concentration Course.
ME 497* Biomechanical Design. 3(3-0). Prereq: ME 371 or concurrently. Biomechanical Concentration Course.
BE 445 Biosensors for Medical Diagnostics. 3(3-0). Prereqs: (BS 161) and (CEM 141) and (ECE 345). Biomechanical Concentration Course. Alocilja.
CHE 483 Brewing and Distilled Beverage Technology. See Override Instruction #3 Below. All lectures and laboratories will take place at 2000 Merritt Road, East Lansing. Prereqs: (Age 21 or higher) and (Senior standing) and (ME 410-Heat Transfer or concurrently). Berglund.
ENE 422 Applied Hydraulics. 3(2-2). Prereq: ME 332. Pokhrel.

Graduate Level Courses: Honors College members and/or students with 3.5+ GPAs might consider taking a graduate course as a senior elective. Before enrolling, several signatures, including that of the instructor, are required. Possible choices for Spring 2015 include ME 802, 814, 825, 828, 861, 872, and 875. See Override Instruction #4 below.

OVERLIE INSTRUCTIONS

1) ME 490—Independent Study Enrollment Procedure: Find a professor who is willing to supervise your independent study, and discuss your plans with him/her. Complete an ME 490/490H Enrollment Contract (independent study form), available in the ME Advising Office in 2560 EB. After you and your professor have completed and signed both sides, return the form to the ME Advising Office for the remaining signatures, override, and enrollment.

2) Complete and submit the ME Override Request Form: http://www.egr.msu.edu/me/form/me-override-request Please note that the ME department cannot overfill required courses to resolve conflicts with Senior Electives, Other Electives, Integrative Studies courses and employment schedules.

3) CHE 483—To request an override, submit the CHE Override Request form: https://www.egr.msu.edu/chems/override/index.php

4) Complete the Graduate Course Override form, available in the ME Advising Office in 2560 EB. This is a paper form.
### Fall Semester Calendar

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>November 14</td>
<td>All currently enrolled students who have not enrolled by 8 p.m. in at least one course for Spring will pay a $50 late fee.</td>
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<tr>
<td>November 5</td>
<td>Senior Elective Night, 6:00 p.m., Location TBD. Sponsored by Pi Tau Sigma.</td>
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<tr>
<td>November 14</td>
<td>Deadline for Withrow Teaching Award Nominations. The nomination form is located at: <a href="http://www.surveymonkey.com/s/9L7XFL8">http://www.surveymonkey.com/s/9L7XFL8</a></td>
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<tr>
<td>Nov 27-28</td>
<td>Thanksgiving recess</td>
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<tr>
<td>December 5</td>
<td>Last day of classes &amp; Design Day.</td>
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<tr>
<td>December 13</td>
<td>Undergrad Commencement Ceremony-Breslin at 2 pm. Lasts about 2 hours. No tickets required.</td>
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<tr>
<td>Dec 8-12</td>
<td>Final Exams</td>
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<tr>
<td>Dec 13-Jan 11</td>
<td>Semester Break</td>
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<tr>
<td>January 16</td>
<td>On-line Open Add Period for Spring 2014 ends at 8 p.m.</td>
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<tr>
<td>March 9</td>
<td>Scheduled Computer/Telephone Enrollment period for summer semester begins.</td>
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<tr>
<td>March 27</td>
<td>Computer Enrollment period for fall/spring 2015-2016 begins. Your enrollment access date will be posted on StuInfo in mid-March.</td>
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MSU is an affirmative action, equal opportunity employer. MSU is committed to achieving excellence through cultural diversity. The university actively encourages applications and/or nominations of women, persons of color, veterans and persons with disabilities.