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Newsletter

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Mission Statement

The CSU Biomedical Engineering Program (BEP) provides an interdisciplinary focus on the cardiovascular, neurological and orthopedic systems, through education, research and service. This unique program combines CSU's strengths in veterinary medicine, engineering and the sciences to improve health, fight disease and aid persons with disabilities.

Please Contact Us!

Alumni, current students and faculty, we would love to receive updates on your career, internships and research for publication in future newsletters.

Send an email to

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Dr. Susan James Named BEP Director

Dr. Susan P. James joined the CSU faculty in 1994 as an assistant professor, and was promoted to Associate Professor and granted tenure in 2000. She is the Founding Director of the CSU Biomedical Engineering Program (BEP). CSU and the College of Engineering recently invested in and institutionalized BEP, a program serving multiple colleges on campus.

Dr. James is also the Associate Department Head of Mechanical Engineering (ME) and regularly serves as Acting Department Head. She is a founding member of the Colorado Alliance for Bioengineering (CAB) serving as the Director since 2004. Dr. James is an accomplished scholar in the areas of biomaterials and medical devices, authoring 69 peer-reviewed journal articles, conference papers and conference proceedings.

As primary advisor, Dr James has graduated 5 Ph.D and 20 Masters students, and is currently advising 4 MS students (2 of whom plan to do a Ph.D) and one Ph.D student. She is a consummate instructor of biomedical engineering and materials science courses, as well as a strong advocate of diversity in the College of Engineering.

Dr. James is married and lives with her husband of 12 years, Alan Anderson, and two sons, Fritz (8) and Tony (5) in their foothills home in Bellvue, Colorado.

New Faculty Member, Dr. Christian Puttlitz

The College of Engineering is pleased to announce the appointment of Dr. Christian Puttlitz, as a new faculty member in ME/Biomedical. Dr. Puttlitz hails from the University of California at San Francisco, where he served as a Research Fellow, a member of the UCSF/Cal-Berkeley Joint Graduate Group in Bioengineering, and as assistant professor and director of the UCFS/Cal-Berkley Joint Graduate Group in Bioengineering, and as assistant professor and director of the Orthopaedic Bioengineering Research Laboratory (OBRL). He received his baccalaureate in materials science engineering and mechanics at Michigan State, his M.S. in Bioengineering at Clemson and, in 1999, his Ph.D in Biomedical Engineering at the University of Iowa. He joins our BEP and serves with Dr . Susan James as co-director of our OBRL

Dr. Puttlitz is a strong research and prolific writer with more than 20 journal articles published or in review and more than 50 book chapters, abstracts, and conference presentations. Much of his work is published in the journal *Spine*, which indicates his research focus is on mechanics issues of the human spine. He specifically focuses on large-scale finite element analyses and experimental studies of the spine examining issues such as the effects of spinal fusion on surrounding vertebra and tissue. While spinal fusion has been widely used for a very long time to "solve" spinal problems in humans, it is far from a panacea, and Dr. Puttlitz's work has gone a long way to elucidate the real issues.

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Biomedical ENGINEERING AT COLORADO STATE UNIVERSITY

Student Summer Internships

Adam Biegen
Jeff Harris
Christian Lee
Adam Lesiak
Robert Nelson

Adam Biegen: *Biomedical Clinical Practicum, Mechanical Engineering Major*

"During the summer of 2005 I worked for a medical equipment device management company, Hospital Shared Services, which is contracted by Children's Hospital in Denver. This company provides clinical engineering support for medical devices throughout the hospital."

"My primary projects were researching a medical device integration, preventative maintenance and repair of infusion pumps, syringe pumps, physiological monitors, gas analyzers, and hypothermia units. I was privileged to work with a biomedical engineer on a design for a pain management cart for the anesthesia department."

"I attended and participated in, medical procedures done at the hospital, including attending an open heart surgery and a spine fusion surgery. I also had the opportunity to participate in data collection at the clinical gait analysis lab."

"My internship was a great learning experience about clinical and biomedical engineering."

Jeff Harris: *Clinical Practicum, Mechanical Engineering Major*

"I participated in the two credit Biomedical Practicum. This practicum gave me the chance to experience research in the field while working in a bio-materials research lab. I gained experience working on a team with all of the advantages and challenges that lie within a team."

"I helped prepare and produce a new (never produced before) bio-material, and performed cell cultures as preliminary research (chondrocytes, cells that make up cartilage) on a layer of bio-material to determine if the material will sustain cell life and how well. I viewed my first surgical procedure where cells used for testing were harvested."

"This incredible experience has given me a chance to participate in a research lab and helped me to make a decision on my career goals after my undergraduate degree. I will pursue a Master's degree while working in the very same lab."

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Seminar - Dr. Kevin Shelburne

Dr. Shelburne is Assistant Director of the Biomechanics Research Laboratory at the Steadman-Hawkins Research Foundation in Vail, Colorado. After receiving his BS and MS in Mechanical Engineering from Texas A&M University, Dr. Shelburne worked as a Engineer at McDonnell Douglas Space Systems where he designed and tested robotic assembly and servicing tasks for the International Space Station. Kevin completed his PhD in Mechanical Engineering at the University of Texas at Austin in May 1997.

Dr Shelburne visited our campus on Nov 11, 2005 and presented a seminar titled"*Exploring Human Knee Mechanics with Modeling and Simulation.*"

A balance of forces from muscles, ligaments, bones, and external loads achieves stability of the knee. Understanding the interaction of these forces requires a combination of *in vivo* and *in vitro* measurements, and computer modeling and simulation. Unfortunately, direct measurement of forces at the knee *in vivo* is impracticable. And, although many studies have recorded some of these quantities *in vitro*, the loading applied to the cadavers in these experiments is often unlike and far less than the forces applied by the muscles during activity. Computer modeling and simulation builds a theoretical framework upon what can be measured *in vivo* and *in vitro* and uses this framework to estimate what cannot be measured. This presentation describes the theoretical framework and its application to study the knee. Our approach is based on detailed mathematical models of the geometry and properties of the bones, soft tissues, and muscles of the knee and lower limb. To calculate forces at the knee, these models are placed into inverse and forward dynamics computer simulations of human activity.

Seminar - Breton Line

Breton Line earned his BS in Mechanical Engineering with a Certificate in Biomedical Engineering from CSU. Following graduation he spent a year teaching math and science at a rural public school. He is currently an engineer at the Woodridge Spine Center where he is involved in bio-mechanical and clinical research pertaining to the spine.

The majority of his research is devoted to spinal deformities such as scoliosis. The biomechanical research that Bret performs utilizes motion tracking systems to evaluate intervertebral motion. Clinically, he is involved in the statistical analysis of the outcomes of different surgical techniques and the development of an adult deformity classification system.

Bret visited campus on Feb 3, 2006 and presented a seminar titled *"Biomechanics of the Thoracic Spine Following Instrumentation for Hyperkyphosis*"

Sagittal plane deformities, such as Scheuermann's disease, can lead to a poor cosmesis, back pain, neurological and pulmonary compromise. Treatment currently utilizes stainless steel or titanium rods placed in the anterior, posterior, or a combination of the two regions of the spine. Fusion treatments are intended to provide up to 50% correction, as well as maintenance of the correction. Bracing, a more conservative therapy, is available. However, because of noncompliance issues amongst adolescents, this therapy often fails. So that the patient can maintain a normal range of motion following correction of the deformity, a fusionless treatment is desired. A posterior tether has been developed to modulate sagittal plane growth of the spine. Biomechanic, radiographic, and histologic results from an ovine study show that this is a potentially viable means of treating Scheuermann's disease. However, until it is available in humans, there is a need to optimize posterior constructs in order to reduce surgical cost while providing the best possible clinical outcome.

Dr. Susan James Develops Innovative Implant Material to Improve Quality of Life for Patients with Joint Pain

Dr. Susan James, associate professor, in Mechanical Engineering and director of the Biomedical Engineering Program, has spent much of the last decade developing a biologically enhanced, self-lubricating bearing material. Polymer science combined with tissue engineering created a new material that may allow human joints to survive much longer than current technology allows. The new biologically enhanced material could benefit younger, more active joint-pain patients, particularly Baby Boomers (people born between 1946 and 1964).

To develop and market the commercial product, Dr. James and CSU are working with project director Herb Schwartz, president and CEO of Schwartz Biomedical LLC, an Indiana-based orthopedic company, and a technology business incubator, the Northeast Indiana Innovation Center.

Technology for the joint implants exists at CSU but will be transferred to Indiana, where most implant manufacturers are based. The 21st Century Research and Technology Fund in Indiana is sponsoring the collaborative project.

Dr. James developed material that has improved wear-resistance over the conventional bearing material commonly used in total joint prostheses resulting from the infusion of a glycosaminoglycan. Glycosaminoglycan is found within the knee and hip joints of the body. It lubricates normal joints and reduces frictional forces on contacting surfaces.

The new joint implant material will have the same role of providing a self-lubricating surface for the patient. The end result could be that the patient would have a longer lasting total joint, reducing the risk for revision surgery. The new biologically enhanced material could also revolutionize the surface replacement market.

Surface replacements have had mixed clinical success due to "unnatural," poorly lubricated traditional joint replacement materials. The new material may provide less invasive treatment options to surgeons for the treatment of hip and shoulder trauma where total joint replacement is not immediately necessary. Young patients could benefit from the longer-lasting joint material used in surface replacement procedures; it will buy them time until total joint replacement is required.

Additionally, Schwartz Biomedical, LLC plans to market new applications of the materials - in tissue engineering, biologics and sports medicine, for example, to orthopedic and medical device companies in Indiana.

Schwartz Biomedical, LLC, develops innovative tissue engineering solutions to orthopedic problems. The company has an established track record in generating innovative solutions in orthopedics and tissue engineering with more than 25 U.S. patents issued or pending.

The Northeast Indiana Innovation Center is a community technology business incubator designed to accelerate the growth and success of entrepreneurial companies through an array of business support services. Their main goal is to produce successful firms that will leave the incubation program financially viable and freestanding and produce successful firms that will leave the incubation program financially viable and freestanding.

***Christian Lee**:*

Internship at the FDA,Masters of Engineering Major

"I traveled to Washington D.C. to work in the Office of Science and Engineering Laboratories (OSEL), part of the Center for Devices and Radiological Health (CDRH) at the Food and Drug Administration (FDA). I worked under Dr. Robert Jennings, research physicist in the Division of Imaging and Applied Mathematics (DIAM) in OSEL"

"I had the honor of assisting Dr. Jennings on two of his projects. The first project dealt with modifying and debugging a program that can mathematically simulate x-ray spectra passing through filters. The program was coded in FORTRAN and originally intended for use in research only. I helped get the program into a publishable state, which included fixing known errors and making the program user friendly. The second project dealt with a mammography machine that had been physically modified to optimize patient dose and image performance based on calculations by Dr. Jennings and others at NIH and FDA. We modified the system further to change the machine from a screen/film detection system into a digital detector system to allow research in the advancing field of digital mammography. To accomplish this we physically modified the machine, adding a digital detector and calibrating software to correctly acquire an image. Also, I had many opportunities to listen during regulatory meetings to see how the FDA operates."

"CDRH is known by most in the biomedical device field as the regulatory agency they must pass their products through to get them on the market. While the regulatory component is a large part of what CDRH does, there is much more to the center. OSEL is highly regarded in the research they do for the scientific community. They publish many papers every year. From my observation, much of the operations at OSEL are similar to what we might see in our CSU labs."

"Going into this internship, my main goal was to learn about how the FDA regulatory process worked. While this goal was met, I left with so much more, including a better understanding of medical imaging and the mathematics involved. Overall, this experience was amazing and has been one of the highlights of my graduate education."

Adam Lesiak:

Clinical Practicum, Bio Science Major

"I spent my clinical practicum working in Patti Davies' Human Development Lab. This lab looks at changes in behavior and brain function as children grow into adults. We do so by administering pencil and paper behavioral tasks followed by an EEG brain scan consisting of simple decision making tasks. My job was to aid in setting up of EEG equipment on the participant and run the equipment throughout the run."

"The second part of my practicum was to analyze data recorded in a test participants go through in the EEG portion of the experiment. This portion was called NOD or Novelty Oddball Paradigm. The participant sat listening to tones and was instructed to respond to one particular high tone while also being presented with a continually repeated novel tone and the occasional oddball tone." *(continued on pg 4)*

Adam Lesiak: *(continued)*

Clinical Practicum, Bio Science Major

This paradigm looks at autonomic memory updating processes of the mind where one subconsciously recognizes each tone and distinguishes whether that tone requires a response. I used a program that allowed me to look at averaged waveforms of the brain and score various peaks and troughs to later compare as to whether there are differences in memory updating abilities as children age. Preliminary results find that people continue to mature and improve into their early twenties".

For more information you can look at our website at (http://brainwaves.colostate.edu)."

Robert Nelson:

Clinical Practicum, Mechanical Engineering Major

"I was honored with an internship at the Food and Drug Administration (FDA), Department of Solid and Fluid Mechanics (DSFM), in Rockville, Maryland. I worked under Ronald R. Robinson in labs where tests were performed on devices regulated by the FDA. These tests are sometimes performed due to reports of adverse events and are used to determine the safety and effectiveness of the product."

"One of our current, longstanding projects involved the flow properties in a human vena cava containing a Caval Filter. We have been using the technique of Particle Image Velocimitry of the vena cava model with phantom clots to analyze the flow properties in and around the filter. We explored the Computational Fluid Dynamics (CFD) of these clot and filter combination to validate our data. We are pursuing a similar technique called Planar Laser Induced Fluorescence (PLIF) for a different application. This is a technique similar to PIV, however it allows for visualization of concentration, temperature and velocity. We plan to use PLIF to examine the effect of High Intensity Focused Ultrasound (HIFU) on human tissue in areas other than the focal region."

"I was fortunate to have this valuable internship. It allowed me to see engineering in every day life and outlined the importance of engineering in creation of lifesaving medical devices. I will keep in contact with the lab and possibly return next summer."

Dr. Christian Puttlitz *(continued from pg 1)*

Dr. Puttlitz is teaching our BE/ME 470/570 course, Orthopaedic Biomechanics, offered jointly by the ME department and Biomedical Engineering Program (BEP), which attracts students from engineering majors, as well as veterinary medicine/biomedical sciences and physics. Future teaching interests include adding graduate courses in biosolid mechanics and advanced biomechanics, emphasizing issues such as orthopeadic implant design to focus graduate students on issues such as writing and speaking skills, in addition to their fundamental technical and research skills.

Dr. Puttlitz will continue his research on large-scale finite element analysis at the OBRL and he plans to build additional testing equipment for data comparison. He also plans to add computing capability including an ABAQUS license for the lab. With these upgrades, he can analyze and test both spinal fusions and vertebral disk implants in the spine to develop capability for presurgery prediction of spinal outcomes on patients - a long sought-after but very elusive capability. His research currently is funded by private companies, and he plans to submit proposals to the National Science Foundation and the Natural Institutes of Health to further fund his ongoing research.

Events

Engineering Career Fair

The 2006 Engineering Career and Internship Fair was held Tuesday, January 31st, 1:00 p.m. - 3:30 p.m. in the Lory Student Center Main Ballroom. An informal reception followed at 3:30 p.m.

Our first Engineering Career Fair was held in January of last year. Civil and Mechanical Engineering participated and the fair drew 200 students and 27 company exhibitors.

This year, Civil and Chemical and Biological Engineering were joined by Mechanical Engineering and the Biomedical Engineering Program. Our company participation increased to 60 and out student participation increased to approximately 350.

Our Career Center engineering liaison, John Haines, held workshops for students to help them prepare, and to "put their best foot forward" for the event. Companies had direct access to our top students in these programs.

We received many great complements from the companies who participated. They were very impressed by our students and how well prepared they were for the event. We are already planning for a bigger and better event next January.

The Orthopaedic Bioengineering Research Laboratory
Colorado State University

The OBRL is part of a consortium for musculoskeletal related research developed at CSU. The consortium's research resources include cell culture, microarray and molecular biology facilities; bone and soft tissue histology; bone densitometry; veterinary surgical facilities, surgeons and animal care; gait/motion analysis and force plating; biomechanical testing and computer modeling; biomaterials development and testing; and a computer modeling/finite element analysis facility. The musculoskeletal research laboratory is located adjacent to the Veterinary Teaching Hospital campus just south of the main CSU.