Dear Friends,

A year ago, I wrote about a new initiative to establish the Cal Poly Human Motion Biomechanics (HMB) Lab (hmblab.calpoly.edu) with the goals of 1) integrating research & education in an interdisciplinary setting at Cal Poly and 2) identifying safe exercises for subjects who are at high risk for knee joint osteoarthritis. Osteoarthritis is a degenerative condition affecting the cartilage and bone tissues of diarthrodial joints and is the leading cause of disability in the US.

Today I am pleased to tell you about our successes over the past year.

**Over the past year, the accomplishments of Cal Poly students in our Biomedical Engineering (BME), Kinesiology (KINE), and Mechanical Engineering (ME) Departments include the following:**

**Setting up our HMB Lab and initiating pilot experiments:** Our interdisciplinary student team has set up our motion analysis system and initiated experimental studies of knee joint biomechanics during gait (i.e. walking) and bicycling. Core team members include graduate students Eshan Dandekar (KINE), Jake Deschamps (ME), Juan Gutierrez-Franco (ME), undergraduate students Karim Dudum (BME), Luke Kraemer (ME), and Alejandro Gonzalez-Smith (ME), visiting Italian student Michele Ermidoro (University of Bergamo), and high school student Sam Pal (San Luis Obispo High School).

**Instrumenting a bicycle with pedal load cells:** Graduate student Juan Gutierrez-Franco (ME) and undergraduate student Luke Kraemer (ME) developed a unique design for attaching load cells to the pedals of our stationary bicycle. The load cells measure forces applied to the subjects’ feet, while the motion analysis system tracks the reflective markers to obtain lower body kinematic data. In the coming months, these students will use these data to predict knee joint loading.

**Developing state-of-the-art methods to reduce soft tissue artifact:** During motion analysis experiments, the reflective markers placed on the skin move along with soft tissues (e.g. skin, fat, muscle) relative to the underlying bones. This introduces errors (called “soft tissue artifact”) because our rigid body dynamics calculations assume the markers do not move relative to the bones. Graduate student Jake Deschamps (ME) developed a novel technique consisting of marker clusters and a mathematical algorithm to reduce these errors when studying knee joint biomechanics. In the coming months, Jake will conduct experiments to validate his model and to more correctly estimate knee joint biomechanics during gait.
Developing knee joint finite element models: Graduate students Meghan Sylvia (ME) and Nick Czapla (ME) developed a computational (i.e. finite element) model of a human knee joint from a MRI scan. Their goal is to predict cartilage tissue loading in subjects who are at high risk of developing knee joint osteoarthritis. In the coming months, Meghan will study cartilage tissue loading in normal- and overweight subjects during gait, while Nick will study alterations to cartilage tissue loading due to anterior cruciate ligament (ACL) injuries and ACL reconstructive surgery.

HMB Lab students benefit from our interdisciplinary collaborative team that spans the landscapes of Cal Poly and the local medical community:

- Professors Steve Klisch, Brian Self, and Hemanth Porumamilla from ME;
- Professors Scott Hazelwood and Saikat Pal from BME;
- Professors Kevin Taylor and Bob Clark from KINE;
- Professor Aydin Nazmi, Director of Cal Poly’s STRIDE (Solutions Through Research In Diet & Exercise) Center;
- Dr. Otto Schueckler, Orthopaedic Surgeon (Central Coast Orthopedic Medical Group);
- Dr. David Tuttle, Musculoskeletal Radiologist (Radiology Associates);
- Mr. Matt Robinson, Certified Orthotist-Prosthetist (Hanger Clinic).

These collaborators work together to mentor our students as well as to develop projects to study knee joint loading in subjects at high risk for osteoarthritis: overweight and obese patients, ACL injured and ACL reconstructive surgery patients, transtibial amputees including US military veterans, and patients with other knee joint injuries.

We are very grateful for the support we receive for our highly talented interdisciplinary team of students, and for our students’ dedication and passion as they develop the HMB Lab!

Please feel free to contact me with any questions or to explore ways in which you, your colleagues, or your employer can support Cal Poly’s HMB Lab.

Donations can be made on-line at www.hmblab.calpoly.edu/giving/

Steve Klisch, Ph.D.

Professor, Mechanical Engineering
Director, Human Motion Biomechanics Lab

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