Program Overview

The Joint Replacement Surgeons of Indiana (JRSI) Research Foundation is a not-for-profit organization committed to fostering the advancement of orthopaedic patient care through clinical and engineering research and education. The Orthopaedic Biomedical Engineering Laboratory is a partnership between JRSI and Rose-Hulman Institute of Technology in which students gain laboratory experience while participating in timely research focused on improving implant design and surgical techniques.

This program update is an overview of the growth of our program and the achievements of our students during the 2013 and 2014 calendar years. In the past two years, JRSI has facilitated in-depth research experiences to 15 undergraduate engineering students, sponsored 4 masters degree candidates in thesis research projects, facilitated 13 summer research internships in the laboratory and 6 additional internships for students of other universities at our clinical research facility in Mooresville, Indiana. Our students have partnered with major orthopaedic manufacturers Stryker Orthopaedics, Biomet, Exactech, and DePuy learning biomechanics research methods while evaluating and improving implant designs and surgical techniques. Additionally, our research facility has undergone substantial improvement to create a unique workspace for a variety of students on the Rose-Hulman campus.
Student Testimonial

Two years ago I had just completed my sophomore year at Rose-Hulman. The internship search is very competitive in the biomedical engineering world and I was blessed to be given the opportunity to work in the JRSI lab. I began working in the JRSI lab in the summer of 2013; my education up to this point had focused on engineering system classes, but I knew very little concerning orthopaedics. Now preparing to graduate in May with two years of experience in the JRSI lab, I feel much more prepared to enter industry or graduate school. My two years of research experience has not only taught me a great deal about orthopaedics and the research field, but has also given me the confidence to graduate from Rose-Hulman knowing that I am competent and ready to take the next step.

The vast amount of experience and exposure to hands-on research I was given is invaluable to my education. My time at JRSI has inspired me to pursue a career in the research world, orthopaedics more specifically.

I cannot speak more highly of the value and enjoyment I have gotten from working with JRSI and Scott Small. Two years ago, I did not have the slightest idea what I wanted to do after I graduated; however, I am much more confident and excited for what the future holds. I am currently pursuing research opportunities at graduate schools. I attribute much of this decision to my time with JRSI, and for that, I am incredibly grateful and blessed.

Sincerely,
Sarah Hensley
The primary aim of the JRSI Foundation is to generate high-quality, peer-reviewed literature in an effort to contribute to the global orthopaedic and engineering communities. In the past two years, research from the JRSI Laboratory was published in the following medical journals and national research conferences:

Medical Journals

**Trabecular Bone Density of the Proximal Tibia as it Relates to Failure of Total Knee Replacement**
Student Author: Jim Merchun

**The Effect of Rotating Platform TKA on Strain Distribution and Torque Transmission on the Proximal Tibia**
Student Authors: Derek Archer and Jordan Oja

**Changes in Tibial Density in Cemented and Uncemented TKA at Ten-Year Follow-up**
Student Author: Jim Merchun

**Tibial Loading after UKA: Evaluation of Tibial Slope, Resection Depth, Medial Shift and Component Rotation**
Student Authors: Derek Archer and Amanda Kingman

**High Initial Stability in Porous Titanium Acetabular Cups:**
A Biomechanical Study
Student Author: Leah Howard
Acetabular Cup Design Influences Deformational Response in Total Hip Arthroplasty
Student Author: Betsy Jones

Acetabular Stiffness and Implant Orientation Change Acetabular Loading Patterns in THA
Student Authors: Leah Howard and Didem Tunc

Conference Presentations

Enhancement of the Biomedical Model of Tibial Loading Following Unicompartmental Knee Arthroplasty
Student Author: Allan Che
Knee Society, Charlotte, NC, October 2014.

Digital Image Correlation Analysis of Tibial Loading in Rotating Platform Total Knee Arthroplasty
Student Authors: Derek Archer and Jordan Oja
Orthopaedic Research Society, San Antonio, TX, January 2013.

Validation of Digital Image Correlation Technique for Strain Measurement in Biomechanical Test Models
Student Author: Derek Archer
ASME Summer Bioengineering Conference, Sunriver, OR, June 2013.

The Effects of Toning Shoes on the Postural Stability of Women
Student Authors: Kevin Farley and Audrey Niverson
American Society of Biomechanics, Omaha, NE, September 2013.
Enhancing the Undergraduate Student Experience

- Students are given opportunities to travel and present research in front of national crowds, including the 2013 American Society of Biomechanics Meeting in Omaha, Nebraska.

- All students are invited to view surgery at the Center for Hip and Knee Surgery in Mooresville, Indiana, and experience clinical application of their research goals and outcomes.

- Students work alongside leading orthopaedic surgeons and industry partners.

- Our summer research program actively works to foster community, networking and team-building within our students.
The summer internship program includes an annual trip to tour regional laboratory and graduate programs. In 2013 students toured Dr. Seth Greenwald’s Orthopaedic Research Laboratory and Case Western Reserve in Cleveland, Ohio. In 2014 we traveled to Chicago, Illinois, to tour Dr. Lee Miller’s Primate Neuromotor Laboratory at Northwestern University, The Rehabilitation Institute of Chicago, and the “Machine Inside” Biomechanics Exhibit at the Field Museum of Chicago.
2013/2014 Students

Anderson Adams
M.S. Class of 2015

Mackenzie Christensen
Class of 2015

James Conwell
Michigan State
Class of 2015

Paige Cook
M.S. Class of 2014

Jeffrey Elliott
Class of 2015

Danielle Gehron
Class of 2017

Gracie Gibbs
Class of 2015

Sarah Hensley
Class of 2015

Michael Kovacs
M.S. Class of 2014
Current Researchers

Emily Lakes  
Class of 2013

Katie Lakstins  
Class of 2016

Philipp Lorenz  
German Exchange  
Class of 2015

Brian McHugh  
Class of 2014

Nate Moore  
Class of 2014

Audrey Niverson  
Class of 2014

Ryan Seale  
Class of 2015

Becca Stevens  
Class of 2014

Brian Sutterer  
M.S. Class of 2014
Current Investigations

- Analysis of Heat Generation and Torque in Deformed Total Hip Arthroplasty Acetabular Components
- Comparison of Manufactured Composite Tibia Models with Native Tissue
- The Effect of Stem Length on Strain and Micromotion in the Proximal Femur Following Total Hip Arthroplasty
- Biomechanical Analysis of Bone Density and Failure in TKA
- Development of a Specimen-Specific Finite Element Model of an Implanted UKA and TKA in the Same Cadaveric Sample
- Analysis of Micromotion in Cementless Total Knee Arthroplasty
Renee Rogge, PhD
Dr. Rogge is a Rose-Hulman faculty member actively involved with the JRSI research program. In recognition of her work, she was recently awarded the **Board of Trustees’ Outstanding Scholar Award**, the **Samuel F. Hulbert Chair of Biomedical Engineering**, and was promoted to Full Professor within the Biology and Biomedical Engineering Department.

Scott Small, MS
Scott has served as the Engineering Director for the JRSI Foundation for eight years and was recently awarded the **2014 Rose-Hulman Distinguished Young Alumni Award**.

Tatsuya Sueyoshi, MD, PhD
In April 2014, with the help of the Rose-Hulman Global Programs Office, JRSI welcomed Dr. Sueyoshi as a 2-year research fellow from Kyoto, Japan, working in support of the laboratory alongside our clinical and biomedical engineering students.
Laboratory Facility Updates

Through the continued support of the Lookout Foundation, the Orthopaedic Biomedical Engineering Laboratory has had the ability to adapt to expanding research needs. As our student population has grown and our research methods have expanded, the laboratory developed a desperate need for additional storage space and increased compatibility for work with biohazard tissues. During the summer of 2014, funds from the Lookout Foundation were used to replace aging woodblock tables with stainless steel casework and shelving throughout the laboratory. Storage space for research materials and specimens has greatly improved, creating additional workspace for a wide variety of student project needs. In 2014 we additionally were able to upgrade our fume hood system for increased ventilation and improved materials handling and student safety.
Facility Updates
Interdepartmental Campus Support

As a member of the Rose-Hulman campus community, the Orthopaedic Biomedical Engineering Laboratory is available to support students from other disciplines in equipment training and project support. The laboratory program sponsors mechanical engineering senior design projects each year and has aided with student group testing in the ME421 lab course. We have aided students with vibration and strain analysis during drum head tuning, deformation analysis in simulated breast tissue exams, offered strain gage instruction, and aided in mechanical tests of specimens ranging from extended urethral catheters to bend failure testing of aluminum and steel support rods and varying gages of fishing line.
As a part of the mission of the Rose-Hulman-JRSI relationship, our program is committed to outreach activities which recruit and train young students into the fields of engineering and medicine. Our laboratory continues its participation in the Rose-Hulman Exploring Engineering program. In this program, we invite elementary and middle school students into the laboratory to learn basic engineering principles while demonstrating research equipment and methods. The laboratory has additionally hosted multiple student field trips from the Oaks Academy in Indianapolis, Indiana, as well as private local student tours.
We would like to offer our sincerest gratitude to the following supporters in 2013 and 2014:

The Lookout Foundation
The VWR Foundation
Rose-Hulman Independent Project/Research Opportunities Program
Rose-Hulman Interdisciplinary Research Consortium
Endowment for the Samuel F. Hulbert Chair in Biomedical Engineering

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www.rose-hulman.edu/jrsi

Cover photo courtesy of Rose-Hulman Institute of Technology