

Orthopaedic Biomedical Engineering Laboratory

ROSE-HULMAN INSTITUTE OF TECHNOLOGY
JOINT REPLACEMENT SURGEONS OF INDIANA RESEARCH FOUNDATION



MEETING AGENDA

Rose-Hulman Board of Trustees
Thursday, May 28th, 2009 — 10:00am

History

The Joint Replacement Surgeons of Indiana (JRSI) Research Foundation is a not-for-profit organization committed to clinical and biomedical research in the field of orthopaedics. The mission of the Foundation is: “To foster the advancement of hip and knee replacement surgical procedures, implants, and survivorship in order to improve the long-term function and well-being of the patients who suffer from debilitating arthritis and associated disorders.” A total of well over 400 peer-reviewed journal articles have been published by researchers affiliated with JRSI in the last 20 years.

Collaboration between the JRSI Research Foundation and Rose-Hulman began in 2004 with the sponsorship of two biomedical engineering masters theses. In July 2007, the JRSI Research Foundation expanded the collaboration by hiring Scott Small, MS (Rose-Hulman Class of 2005) to serve as the full-time engineering director to oversee research efforts at Rose-Hulman.

The Orthopaedic Biomedical Engineering Laboratory, located in the John T. Myers Center for Technological Research with Industry, unites the clinical research experience of our orthopaedic surgeons with the engineering expertise of Rose-Hulman in order to create a unique learning environment for students to be actively engaged in clinically relevant, real-world problem solving.

Our laboratory currently has two primary workstations available for student research. The Photoelastic Strain Analysis Workstation consists of a full-field strain acquisition system which allows loading to be measured simultaneously across the entire surface of a bone test specimen. This workstation has been supported in part by **Mr. Howard Freers** and **Mr. Greg Gibson**. The Medical Imaging and Finite Element Analysis Workstation consists of the state-of-the-art MIMICS medical imaging software system. The same technology is currently utilized by major orthopaedic companies in the design of custom implants and patient-specific surgery. This workstation has been supported by **The Lookout Foundation**.

Programming & Projects

Programming

Directed Undergraduate Research Course: Students design testing setups, conduct research projects, and present results during individualized, for-credit, elective courses.

Clinical Education: Students are given the opportunity to observe Dr. Michael Berend perform surgery in the operating room. Students are instructed in the clinical impact of engineering design and have the opportunity to attend research meetings and conferences.

Summer Internship/REU: Students participate in paid summer internships conducting intense research studies as either a full-time JRSI employee or a research grant recipient.

Guest Lectures: JRSI surgeons and staff present guest lectures to students in biomedical engineering classrooms covering topics including research methods, surgery technique, biomaterials, and clinical biomechanics.

Masters Thesis Projects: Graduate students design and conduct high-level, extended research projects with support from RHIT faculty, JRSI surgeons and staff.

Senior Design Projects: JRSI serves as a year-long project sponsor for senior design projects to improve testing methods and experimental setups.

Course Project Sponsorship: JRSI acts as a project client for students doing small design projects in non-research related courses such as ME430-Mechatronic Systems.

Current Projects

- **Tibial Loading Following All-Polyethylene Partial Knee Replacement**
- **Comparison of All-Polyethylene and Metal-Backed Partial Knee Replacement**
- **The Effect of Cup Position on Pelvic Loading Following Total Hip Replacement**
- **Comparison of Photoelastic and Strain Gage Measurement Techniques in Orthopaedic Research**
- **Acetabular Cup Stiffness and Its Effect on Required Insertion Energy**
- **Finite Element Analysis of a Composite Tibia Utilizing CT-based Segmentation**

Student Impact

The creation of the Orthopaedic Biomedical Engineering Laboratory has created opportunities for students of all levels to gain real-world experience in engineering research with its clinical and design applications. Listed below are the students who have been directly involved with, or impacted by the JRSI presence on the Rose-Hulman campus. Particularly of note is the BE545 Orthopaedic Biomechanics Course, in which Dr. Renee Rogge, PhD heavily integrated our Medical Imaging and Finite Element Analysis workstation into the course curriculum.

Directed Undergraduate Research Course

Lucas Alvey (2007-08)
Samantha Dick (2007-08)
Michael Lockhart (2007-08)
Natalie Dickman (2007-08)
Sarah Younger (2008-09)
Michael Volitich (2008-09)
Darcie Thomas (Fall 2009)
Didem Tunc (Fall 2009)

Masters Thesis Projects

James Merk (2004-05)
Kurt Dierking (2004-05)
Christopher Meyer (2005-06)
Scott Small (2006-07)
Susumu Tokunaga (2008– present)

Senior Design Projects

Samantha Dick (2007-08)
Jennifer Gordon (2007-08)
Stephanie Story (2007-08)
Elizabeth White (2007-08)
Susannah Yoder (2007-08)

Course Project Sponsorship

Samantha Dick (ME430, Fall 2007)
Jennifer Gordon (ME430, Fall 2007)
Susumu Tokunaga (BE597, Fall 2008)

Summer Internships/REU's

Scott Small (Summer 2006)
Allison Stultz (Summer 2006)
Jill Watson (Summer 2006)
Margaret Kelly (Summer 2008)
Leah Howard (Summer 2009)
Susumu Tokunaga (Summer 2009)
Michael Volitich (Summer 2009)

BE545: Orthopaedic Biomechanics

(Spring 2009)
Lucas Alvey
Cody Austin
Richard Baker
Elizabeth Bucey
Elaine Houston
Jarod Markley
Rachael Nestor
Megan O'Brien
Timothy Parsons
Arden Santoso
Andrew Steward
Darcie Thomas
Charles Tuskan
Michael Volitich
Kathryn Zawadski

Contacts

Merrill Ritter, MD

JRSI Foundation Director
Professor of Orthopaedic Surgery, IU School of Medicine
1199 Hadley Road
Mooresville, IN 46158
marittermd@mindspring.com
(317) 831-9330

Michael Berend, MD

JRSI Orthopaedic Surgeon
Clinical Assistant Professor, IU School of Medicine
1199 Hadley Road
Mooresville, IN 46158
mikeberend@me.com
(317) 834-5132

John Meding, MD

JRSI Orthopaedic Surgeon
1199 Hadley Road
Mooresville, IN 46158
jmeding@msn.com
(317) 834-5132

Christine Buckley, PhD

Associate Professor of Biomedical Engineering
5500 Wabash Ave., CM 163
Terre Haute, IN 47803
christine.buckley@rose-hulman.edu
(812) 877-8118

Renee Rogge, PhD

Assistant Professor of Biomedical Engineering
5500 Wabash Ave., CM 4032
Terre Haute, IN 47803
renee.rogge@rose-hulman.edu
(812) 877-8505

Scott Small, MS

JRSI Engineering Director
5500 Wabash Ave, CM 4035
Terre Haute, IN 47803
scott.small@rose-hulman.edu
(765) 401-6011

On the Cover

- Top Left:** John T. Myers Center for Technological Research with Industry, the home of the Orthopaedic Biomedical Engineering Laboratory on the campus of Rose-Hulman Institute of Technology.
- Top Right:** Dr. Renee Rogge instructs a student in the use of the MIMICS medical imaging system during a course lecture in BE545-Orthopaedic Biomechanics. This state-of-the-art software system is the core component of our Medical Imaging and Finite Element Analysis workstation.
- Middle Left:** Students Sarah Younger (left) and Michael Volitich (center) with JRSI Engineering Director Scott Small (right) during a visit to the St. Francis Hospital— Mooresville operating room. The students observed Dr. Michael Berend perform total hip, total knee, and partial knee replacement surgeries.
- Middle Right:** A three-dimensional skeletal and soft tissue model created in our laboratory with the MIMICS medical imaging system. The model was created using CT-scan data acquired from a patient at The Center for Hip and Knee Surgery, St. Francis Hospital-Mooresville.
- Bottom Left:** Student Lucas Alvey prepares a photoelastically coated tibia for mechanical testing during a directed undergraduate research course.
- Bottom Right:** The Oxford Partial Knee Replacement System produced by Biomet, Inc. is used by students in our laboratory to test the effects of metal, partial knee replacement designs on loading in the tibia.