JOSHUA D. ROTH, M.S., Ph.D.

2821 River Plaza Drive Apt 30
Sacramento, CA 95833
Email: jdroth@ucdavis.edu

Lab: 530-752-2713
Cell: 925-963-2520
Website: http://www.bme.ucdavis.edu/hull/

Education:

University of California, Davis, CA

Ph.D., Biomedical Engineering, February 2016

Dissertation Title: "How Well Does Kinematically Aligned Total Knee Arthroplasty Prevent Clinically Important Changes in Passive Knee Function? An *In Vitro* Biomechanical Study of Tibiofemoral Laxities and Contact"

Advisor: Professor Maury L. Hull, Ph.D.

Committee: Professor David A. Hawkins, Ph.D., Professor Susan M. Stover, Ph.D., DVM

- **Maury L. Hull Endowed Fellowship**, UC Davis College of Engineering 1/2015
- **BME Graduate Group Travel Award**, UC Davis BME Graduate Group, 6/2014, 6/2015
- **Summer Graduate Student Researcher Award**, UC Davis Graduate Studies, 7/2012-9/2012
- **National Science Foundation Graduate Research Fellowship Program Honorable Mention**, National Science Foundation, 4/2010

M.S., Biomedical Engineering, December 2014

Thesis Title: "The Limits of Passive Motion of the Normal Tibiofemoral Joint: A Benchmark for Modeling and for Total Knee Arthroplasty"

Advisor: Professor Maury L. Hull, Ph.D.

Committee: Professor David A. Hawkins, Ph.D., Stephen M. Howell, M.D.

- **Best Poster Presentation**, UC Davis BME Graduate Group Research Conference, 5/2013

California Polytechnic State University, San Luis Obispo, CA

B.S., Mechanical Engineering, March 2009

- **Engineer-in-training**, National Council of Examiners for Engineering and Surveying (NCEES), Certificate#: 129389

Research Experience:

Postdoctoral Research, UC Davis, 2/2016 – present

Mentors: Professor Maury L. Hull, Ph.D. and Stephen M. Howell, M.D.

- Designed *in vitro* cadaveric study to answer research question: "How Do Flexion-Extension and Varus-Valgus Malalignments of the Tibial Component in Kinematically Aligned Total Knee Arthroplasty Change Laxities and Contact?"
- Designed and manufactured custom tibial components to simulate 1° and 2° malalignments in both flexion-extension and varus-valgus

Dissertation/Thesis Research, UC Davis, 11/2009 – 2/2016

Mentor: Professor Maury L. Hull, Ph.D.

- Designed *in vitro* cadaveric study to answer research question: "How Well Does Kinematically Aligned Total Knee Arthroplasty Prevent Clinically Important Changes in Passive Knee Function?"
- Redesigned six degrees-of-freedom load application to measure the laxities and neutral positions of human cadaveric knees
- Designed, manufactured, and validated a custom tibial contact force sensor for *in vitro* determination of the contact force and center of pressure on each tibial condyle during passive flexion-extension following total knee arthroplasty

Graduate Student Researcher, UC Davis, 6/2010 – 2/2016
Mentor: Stephen M. Howell, M.D.

- Developed protocol to align three dimensional bone models of the lower extremity in standardized planes (the kinematic planes) based on the axes of rotation of the knee
- Developed protocol to measure limb alignment, knee alignment, and the obliquity of the joint line in the kinematic coronal plane on three dimensional bone models of the lower extremity
- Investigated the variability in rotational alignment of lower extremities by imaging technicians for computed tomography scans using three dimensional bone models of the lower extremity
- Investigated why the categorizations of limb and knee alignment are neither valid nor interchangeable for predicting long-term implant survival following total knee arthroplasty

Work Experience:

Medical Device Design Intern, Nitinol Devices and Components, 4/2009 – 9/2009
Supervisor: Craig Bonsignore

- Led international consulting project with company in Germany
- Designed nitinol devices for cardiovascular and neurovascular applications
- Analyzed and characterized designs using both finite element analysis and physical testing

Research and Development Intern, FoxHollow Technologies (now eV3), 6/2007 – 9/2007
Supervisor: Alex Yang

- Interacted weekly with vascular surgeons to ensure that new design concepts met currently clinical needs
- Designed and manufactured test fixture and designed protocol to characterize new plaque excision device concepts
- Assisted team with launch of a calcium cutting device (RockHawk)

Teaching Experience:

Biomedical Engineering Senior Design (BIM 110), UC Davis, Winter/Spring 2010, Winter 2011, and Fall 2013-Spring 2014
Instructors: Angie Louie, Ph.D. and Anthony Passerini, Ph.D.

- Developed curriculum for quarter-long computer aided design workshop using a hybrid teaching approach with a backwards design
- Served as project manager for student design teams
- Provided expert advice on the design, manufacturing, and testing of student design projects
- Helped to organize a quarter-long machine shop training course

Biomaterials (BIM 109), UC Davis, Spring 2013
Instructors: Md Amranul Haque, Ph.D. and Jung Mok You, Ph.D.

- Gave guest lecture titled, "How Do Changes to Knee Kinematics Increase Wear of Ultra High Molecular Weight Polyethylene after TKA?"
- Held weekly office hours
- Lead review sessions for exams
- Developed grading rubrics for assignments

Biomedical Engineering Physiology (BIM 116), UC Davis, Fall 2010
Instructor: Benjamin Jarrett, Ph.D.

- Assisted students with project based learning problems
- Helped develop grading criteria for written assignments

Study Session Leader, Cal Poly Academic Skills Center, 1/2006 - 4/2009
Supervisor: Bill Syndor

- Lead groups of students in instructional sessions to supplement their lectures in subjects including statics, dynamics, mechanics of materials, and physics
- Prepared study material for students to reinforce concepts covered in the sessions

Publications:

1. **Roth, JD**, Howell, SM, Hull, ML. How Well Does Kinematically Aligned Total Knee Arthroplasty Prevent Clinically Important Changes in Laxities and Shifts in Neutral Positions of the Knee? J Bone Joint Surg, In Preparation
2. **Roth, JD**, Howell, SM, Hull, ML. How Well Does Kinematically Aligned Total Knee Arthroplasty Prevent Clinically Important Contact Force Imbalances and Abnormal Contact Kinematics? J Bone Joint Surg, In Preparation
3. **Roth, JD**, Howell, SM, Hull, ML. How Does Varus-Valgus Malalignment of the Tibial Component in Kinematically Aligned TKA Change the Laxities and Contact? J Bone Joint Surg, In Preparation
4. **Roth, JD**, Howell, SM, Hull, ML. How Does Flexion-Extension Malalignment of the Tibial Component in Kinematically Aligned TKA Change the Laxities and Contact? J Bone Joint Surg, In Preparation
5. **Roth, JD**, Hull, ML, Howell, SM. An Improved Tibial Contact Force Sensor to Compute Contact Force and Location *In Vitro* after Total Knee Arthroplasty. *J Biomech* In Preparation
6. **Roth, JD**, Hull, ML, Howell, SM. A Novel Error Correction Algorithm for the Contact Location Computed between Curved Surfaces: Application to Total Knee Arthroplasty. *J Biomech Eng*, In Preparation
7. **Roth, JD**, Howell, SM, Hull, ML. Native Knee Laxities at 0°, 45°, and 90° of Flexion and their Relationship to the Goal of Gap-Balancing a Total Knee Arthroplasty. *J Bone Joint Surg* **97(20)**, 2015
8. **Roth, JD**, Hull, ML, Howell, SM. The Limits of Passive Motion Are Variable Between and Unrelated Within Normal Tibiofemoral Joints. *J Orthop Res* **33(11):** 1594-1602, 2015
9. Howell, SM, **Roth, JD,** Hull, ML. Kinematic Alignment in Total Knee Arthroplasty. Definition, History, Principle, Surgical Technique, and Results of an Alignment Option for TKA. *Arthropaedia* **1:** 44-53, 2014
10. Gu, Y, **Roth, JD,** Howell, SM, Hull, ML. How Frequently Do Four Methods for Mechanically Aligning a Total Knee Arthroplasty Cause Collateral Ligament Imbalance and Change Alignment from Normal in White Patients? *J Bone Joint Surg Am* **96(12):** e101, 2014
11. Nedopil, AJ, Howell, SM, Rudert, M, **Roth, JD**, Hull, ML. How Frequent Is Rotational Mismatch Within 0±10 in Kinematically Aligned Total Knee Arthroplasty? *Orthopedics* **36(12):** e1515-e1520, 2013

Abstracts and Presentations:

1. **Roth, JD,** Hull, ML, Howell, SM. How Well Does Kinematically Aligned Total Knee Arthroplasty Prevent Clinically Important Changes in Laxities and Shifts in Neutral Positions of the Knee? *Annual Meeting of the Orthopaedic Research Society* Orlando, FL, **Poster 1010,** 2016
2. **Roth, JD,** Hull, ML, Howell, SM. Design, Calibration, and Validation of a Novel *In Vitro* Tibial Force Sensor. *Summer Biomechanics, Bioengineering and Biotransport Conference* Snowbird, UT, **Podium DDR03,** 2015
3. **Roth, JD**, Hull, ML, Howell, SM. Do The Laxities of the Normal Knee at 0° And 90° Of Flexion Support The Goal Of Gap-balancing A Total Knee Arthroplasty? *Summer Biomechanics, Bioengineering and Biotransport Conference* Snowbird, UT, **Podium SM18,** 2015
4. **Roth, JD**, Hull, ML, Howell, SM. How Does Transecting the Anterior Cruciate Ligament Change the Limits of Passive Motion and Affect the Clinical Assessment of Laxity in TKA? *Annual Meeting of the Orthopaedic Research Society* New Orleans, LA, **Poster 808,** 2014
5. **Roth, JD**, Howell, SM, Hull, ML. Laxities of the Normal Knee at 0° and 90° Flexion: A Benchmark for Assessing Soft Tissue Balance in TKA. *Annual Meeting of the Orthopaedic Research Society* New Orleans, LA, **Poster 855,** 2014
6. Brar, AB, **Roth, JD**, Howell, SM, Hull, ML. Can Tibial Reference Lines Common to Mechanically Aligned TKA Be Used to Set Tibial Component Rotation in Kinematically Aligned TKA? *Annual Meeting of the Orthopaedic Research Society* New Orleans, LA, **Poster 1745,** 2014
7. Gu, Y, **Roth, JD**, Howell, SM, Hull, ML. How Frequently Does Mechanically Aligning a Total Knee Arthroplasty with the Knee Set at 5° or 7° Valgus Cause Collateral Ligament Imbalance and Change Alignment from Normal? . *Annual Meeting of the Orthopaedic Research Society* New Orleans, LA, **Poster 1731,** 2014
8. Gu, Y, **Roth, JD**, Howell, SM, Hull, ML. Does Mechanical or Kinematic Alignment in TKA Cause Instability and Change Limb and Knee Alignment From Normal? *Annual Meeting of the American Academy of Orthopedic Surgeons* New Orleans, LA, **Scientific Exhibit 46,** 2014
9. **Roth, JD**, Gu, Y, Howell, SM, Dossett, HG, Hull, ML. Principles and Results of Kinematic Alignment: An Option for Total Knee Arthroplasty. *Annual Meeting of the American Academy of Orthopedic Surgeons* New Orleans, LA, **Scientific Exhibit 45,** 2014
10. Nedopil, AJ, Brar, AB, **Roth, JD**, Howell, SM, Hull, ML. Rationale, Techniques, and Reliability of Aligning TKA Components Parallel to the Sagittal Kinematic Plane. *Annual Meeting of the American Academy of Orthopedic Surgeons* New Orleans, LA, **Scientific Exhibit 52,** 2014
11. Brar, AB, **Roth, JD**, Howell, SM, Hull, ML. Do Five Tibial Reference Lines Reliably Align the Tibial Component Parallel to the Sagittal Kinematic Plane of the Knee? *Annual Meeting of the American Academy of Orthopedic Surgeons* New Orleans, LA, **Poster 119,** 2014
12. **Roth, JD,** Howell, SM, Hull, ML. Envelopes of Passive Motion in the Intact Tibiofemoral Joint: An In Vitro Study. *ASME Summer Bioengineering Conference* Sunriver, OR, **Podium 15-2-2 Extremity II,** 2013
13. Roth, JD, Gu, Y, Howell, SM, Hull, ML. Considerations for Measuring Coronal Alignment and an Analysis of Total Knee Arthroplasty Alignment Techniques. *Annual Meeting of the American Academy of Orthopedic Surgeons* San Francisco, CA, **Scientific Exhibit 20,** 2012
****invited to submit manuscript to the Journal of Bone and Joint Surgery because exhibit was one of the highest graded exhibits at the 2012 AAOS meeting***

Outreach:

E-Mentor, Sheldon High School Biotechnology Academy, 9/2014-12/2014, 2/2016-6/2016
- Provided academic advise related to study habits, college applications, and career development to a high school student

Resume Reviewer, UC Davis Biomedical Engineering Society, 1/2013, 10/2013, and 1/2014
- Reviewed resumes for undergraduate students seeking industry and research jobs
- Provided guidance for applying to both industry and research jobs

Member of Undergraduate Advising Panel, UC Davis Biomedical Engineering Society, 11/2011, 5/2012, and 5/2013
- Provided guidance to undergraduate students about how to succeed academically, how to obtain an industry internship, and how to find research opportunities

Presenter at Undergraduate Research Fair, UC Davis Biomedical Engineering Society, 1/2011, 1/2012, 1/2013, and 1/2015
- Presented ongoing research in Orthopedic Biomechanics Lab to undergraduates interested in joining a research group
- Provided guidance to undergraduates about how to obtain a research position

Outreach Chair, UC Davis Biomedical Engineering Student Association, 6/2010- 6/2011
- Organize educational outreach visits for Sacramento K-12 schools to inspire students to pursue higher education in math and science
- Developed story-based learning activities to explain my research on knee mechanics after total knee arthroplasty to K-12 students through hands-on activities
- Schedule community service activities for the Biomedical Engineering Department such as working at soup kitchens and Adopt-a-Family program

Outreach Member, UC Davis Biomedical Engineering Student Association, 9/2009- Present
- Lead educational outreach visits for Sacramento K-12 schools to inspire students to pursue higher education in math and science

Mentoring and Advising:

Undergraduate Researchers:

1. Elisma Botha, ME/BME, (1/2011 – 1/2013), Undergraduate Honors Thesis, *Effect of Varus-Valgus Malalignment of Femoral Component on the Limits of Passive Motion after Total Knee Arthroplasty*
2. Stephanie Gu, BME (6/2010-6/2011), Undergraduate Thesis, *Virtual Analysis of Total Knee Arthroplasty Surgical Alignment Techniques*
3. Abheet Brar, BME (4/2012 - 6/2013), Undergraduate Research, *Virtual Evaluation of Rotational Alignment Landmarks for the Tibial Component in Total Knee Arthroplasty*
4. Ben Picket, ME (3/2011 – 6/2011), Undergraduate Research, *Considerations for Measuring Coronal Alignment*
5. Elizabeth Ho, BME (7/2010 – 6/2012), Undergraduate Research, *Considerations for Measuring Coronal Alignment* and *Design and Manufacturing of Surgical Fixture for In Vitro Total Knee Arthroplasty*
6. Kevin Butler, ME (4/2012 – 6/2015), Undergraduate Research, *Do flexion-extension errors in the placement of the femoral component in total knee replacement surgery affect laxity?* and *Design of Novel Patellofemoral Contact Force Sensor*
7. Christopher Shelver, ME/BME (7/2012 – 3/2015), Undergraduate Research, *Considerations for Measuring Coronal Alignment* and *Design of Novel Patellofemoral Contact Force Sensor*
8. Natasha Jarrett, BME (4/2013 – 9/2015), Undergraduate Research, *Virtual Analysis of Total Knee Arthroplasty Surgical Alignment Techniques* and *Design and Manufacturing of Mechanical Knee Model that Replicates Low and High Stiffness Laxity*

9. Alison Chen, BME (6/2013 – 6/2014), Undergraduate Research, *Design and Manufacturing of Mechanical Knee Model that Replicates Low and High Stiffness Laxity*
10. Kyle Catabay, NPB (1/2012 – 6/2013), Undergraduate Research, *Cadaveric Knee Dissection*
11. Joseph Korresel, NPB (8/2011 – 6/2013), Undergraduate Research, *Cadaveric Knee Dissection*

Certifications:

Learner-Centered Teaching, UC Davis Center for Excellence in Teaching and Learning, 9/2013

- Created quarter-long teachable unit using a backwards design to help students meet weekly learning objectives
- Wrote statement of teaching philosophy
- Learned about different ways to bring technology into the classroom

Certified LabVIEW Associate Developer, National Instruments, 9/2014-9/2015

- Developed foundational proficiency in the use of LabVIEW for test and measurement applications

Professional Affiliations:

- **American Society of Mechanical Engineering (ASME)**, 2007-present
- **American Society of Engineering Education (ASEE)**, 2010-present
- **Pi Tau Sigma**, National Mechanical Engineering Honor Society, 2007-present