

Ali Yawar

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SUMMARY

- In-depth knowledge of the anatomy and mechanics of the human foot as learned through a combination of mathematical modeling, anatomical dissection, cadaver testing, and *in vivo* human experiments
- Expert at visualization, computer aided design and mechanical fabrication of experimental equipment using a combination of metal and wood machining, 3D printing, and laser cutting techniques
- Well versed in experimental techniques such as motion capture, photogrammetry, CT scan reconstruction, and high speed video recording directly applied to human foot function
- Proficient in data analysis and visualization using programming software (MATLAB, Python, R), design software (SolidWorks, Adobe Illustrator, OpenSCAD), clinical CT scan reconstruction software (ITK-SNAP, Slicer3D), microcontroller programming (Arduino, Assembly), and version control software (Git)
- Able to convey methods and results to audiences with wide ranging backgrounds
- Skilled at planning and organizing teams and meeting deadlines

PROFESSIONAL EXPERIENCE

Yale University

2015-present

Graduate Student, Biomechanics and Control Lab
Advisor: Prof. Madhusudhan Venkadesan

Research focus on the form and function of human feet

- Conducted human subject experiments to demonstrate the [contribution of the foot's transverse arch to its stiffness](#) *in vivo* for the first time
- Demonstrated the ability to increase foot stiffness by externally reinforcing the forefoot without any surgical intervention
- Modeled and evaluated a novel method for foot stiffness estimation based on the windlass mechanism of the foot
- Mentored an undergraduate student to design a custom rig with which to measure foot stiffness
- Designed and fabricated mechanical models of human feet and conducted load displacement measurements in order to assess the dependence of foot stiffness on transverse curvature

Cadaver experiments

- CT scanned fresh human foot cadavers with the ability to register foot bone geometry to bone movement under load (as an alternative to XROMM)
- Dissected cadavers to selectively release soft tissues (plantar fascia, deep transverse metatarsal ligaments) to measure their contribution to foot stiffness
- Conducted load-displacement measurements using a materials testing machine to evaluate foot stiffness with various soft tissues sequentially released
- Designed and fabricated a rig to assess stiffness dependence on the extent of windlass engagement in the cadaver foot

Mathematical modeling and experimental analysis of joint motion

- Co-designed and oversaw fabrication of a joint mobility measurement experiment to determine the direction and range of motion in an animal joint, such as the tarso-metatarsal joint in the human midfoot
- Applied principles of differential geometry to simulated and real joint surfaces reconstructed from CT scans to develop a predictive theory of joint motion

Teaching fellow in mechanical engineering

- Senior Mechanical Design (Fall 2016) and Mechatronics (Spring 2018, Spring 2019) with exceptionally positive reviews as a mentor and teacher
- Responsible for mentoring student design projects and managing lab sections with live coding and prototyping of electronic circuits and mechanisms

Okinawa Institute of Science and Technology, Okinawa, Japan

2015

Research Intern, Collective Interactions Unit

Advisor: Prof. Mahesh Bandi

- Designed and conducted experiments to perform multi-camera high speed video capture and analysis of free falling water droplets impacting flowing soap films
- Achieved high quality video recordings of fast droplet collision events (≤ 1 ms), along with interferometry to measure small fluctuations in the soap film
- Implemented image segmentation and object tracking for large image datasets in MATLAB to track the kinematics of the falling droplets
- Performed high speed video recordings of the flowing soap film with a high power laser illumination for PIV measurements
- Recipient of the [best paper of 2018](#) award from Fluid Dynamics Research for this work

École polytechnique fédérale de Lausanne, Lausanne, Switzerland

2014

Research Intern, Learning Algorithms and Systems Laboratory

- Developed code using Robot Operating System (ROS) for motion capture experiments to quantify hand movements in a cooperative mimicking game and conducted experiments with human subjects
- Wrote a wrapper in MATLAB to expand the usability of in-house humanoid XML descriptor files

Technical University of Hamburg-Harburg

2013

Research Intern, Institute of Control Systems

- Simulated ZMP-based control of walking on the humanoid robot Nao with the goal to maximize speed while maintaining dynamic stability

EDUCATION

Yale University, New Haven, CT, USA

expected 2021

Ph.D. (post-candidacy), Mechanical Engineering, GPA 3.64

Advisor: Prof. Madhusudhan Venkadesan

Thesis - Structural principles underlying foot function

Indian Institute of Technology Roorkee, Roorkee, India

2014

Bachelor of Technology, Mechanical Engineering, GPA 9.29/10

Senior thesis - Design and characterization of a bristled frictional motor with muscle-like constitutive properties