Baiyu Shi

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RESEARCH INTERESTS

Robotics: Medical Robotics, Chemical and Haptics Sensing, Robot Learning and Manipulation, Soft/Bio Robotics.
Wellness Monitoring: Biosensors, Wearable Devices, BioMEMS, Biophotonics, Medical Imaging, Organ-on-a-Chip.

EDUCATION

University of California, Berkeley   **Berkeley, CA**
B.S. Bioengineering, Electrical Engineering and Computer Science   *September 2019 – Expected May 2023*
- GPA: **3.977**/4.00 with Dean's List for 4 semesters and Honors to Date for all semesters.
  EECS Honors Program with concentration in biomedical devices.
- Relevant Courses:
  - EECS: Robotics Manipulation and Interaction (A+), Introduction to AI (A+), Machine Structures (A+), Design Information Devices and Systems 1&2 (A), Concepts of Probability (A), Data Structures (A)
  - BioE: Molecular and Cellular Biophotonics (TA), Engineering Molecules 1&2 (A+), Biological Transport (A+), Biomedical Physiology (A+), BioMEMS and Medical Devices (A)

PUBPLICATION

[1] **AutoBag: Learning to Open Plastic Bags and Insert Objects.**
Lawrence Yunliang Chen, **Baiyu Shi**, Daniel Seita, Richard Cheng, Thomas Kollar, David Held, Ken Goldberg.
                    IEEE International Conference on Robotics and Automation (ICRA), May 2023, London, UK.
[2] **Automating Vascular Shunt Insertion with the dVRK Surgical Robot.**
Karthik Dharmarajan*, Will Panitch*, Muyan Jiang, Kishore Srinivas, **Baiyu Shi**, Yahav Avigal, Huang Huang, Thomas Low, Danyal Fer, Ken Goldberg.   *IEEE International Conference on Robotics and Automation (ICRA)*, May 2023, London, UK.
[3] **A Trimodal Framework for Robot-Assisted Vascular Shunt Insertion When a Supervising Surgeon is Local, Remote, or Unavailable.**
Karthik Dharmarajan*, Will Panitch*, **Baiyu Shi**, Huang Huang, Lawrence Yunliang Chen, Thomas Low, Danyal Fer,
Ken Goldberg.   *IEEE International Symposium on Medical Robotics (ISMR)*, April 2023, Atlanta, USA.

RESEARCH EXPERIENCE

Neuromechanics Analysis of Dynamic Ground Righting Maneuvers in Lizards   **Berkeley, CA**
Advisor: Prof. Robert J. Full   *June 2021 – Present*
- Aims at uncovering templates for lizard righting behavior through camera recorded trials with novel data-driven approach.
- Developed a time-efficient and labor-saving pipeline for 3D pose estimation from lizard videos that involves filtering, manual inspections, and DLT reconstruction based on ensembled Resnet50 CNNs (Deeplabcut Implementation). It offers equal accuracy as complete manual labeling with 5X speedup.
- Pipeline adopted by other PhD students investigating squirrels and crabs.

Designing and Fabricating Diagnostic Contact Lenses with Multiplex Biomarker Detection Capability   **Berkeley, CA**
Advisor: Prof. Gerard Marriott   *July 2022 – Present*
- Proposed using UV-labile thiol protection groups to selectively pattern multiple antibodies onto contact lenses for multiplex biosensing contact lenses with potential for quantitative concentration readout.
- Demonstrated success of the UV-based antibody patterning system on self-made PDMS lenses and commercial lenses with ELISA and fluorescence microscopy.
- Fabricated and compared lenses based on different formulas.

AutoBag and Automatic Vascular Shunt Insertion (AVSI)   **Berkeley, CA**
Advisor: Prof. Ken Goldberg   *May 2022 – Present*
AutoBag is an algorithm that perceives and opens an unstructured plastic bag, insert objects in the bag and lifts the bag. Autobag has partial success rate of 67% for both tier1 and tier2 train bags and tier1 test bags and 50% for tier2 test bags.
- Proposed a UV-based self-supervised data collection system at 110 samples per hour for bag segmentation.
- Modified and trained ensemble U-Nets to generate semantic segmentations for bags with IoU of 77%.
- Proposed the representation of a plastic bag with its opening size and major minor axis ratio.
- Integrated self-designed action primitives with perceptions and implemented Autobag as a finite state machine.

AVSI Trimodal Framework is a system that assigns robotic surgical assistants different roles based on local surgeon availability. It has success rates of 80-95% on **Automatic Vascular Shunt Insertion** and 70-100% on autonomous vessel dilation.

- Helped implement PID and gripper recognition network-based and ensemble neural network-based visual servoing to combat unavoidable slips and hysteresis from cable-driven systems.
- Helped implement RANSAC based vessel opening estimation and formulate the problem of automated vascular shunt insertion with bimanual surgical robot.

OTHER EXPERIENCE

Shanghai View Precision Machinary Co.   **Shanghai, China**
Role: Mechanical Engineer Intern in Mold Design and Quality Control   *Jan 2021- Mar2021*
- Designed molds via AutoCAD for cold forging presses and coded Mazak CNC machines to manufacture gears in electrical tools.
- Conducted metallographic analysis to examine purity of metals and the quality of heat treatment.

BioE 163 Principles of Molecular and Cellular Biophotonics   **Berkeley, CA**
Role: Graduate Student Instructor (GSI)   *Aug 2022 – Present*
- Led weekly discussions of 30 students covering lecture contents, worksheets, and relevant publications.
- Drafted and graded assignments on Gradescope.

BioE 163L Molecular and Cellular Biophotonics Laboratory   **Berkeley, CA**
Role: Graduate Student Instructor (GSI)   *Starting Jan 2023*

PROFESSORIONAL SERVICE

Conference Reviewer for *IEEE International Conference on Robotics and Automation (ICRA)*, 2023

PROJECTS

Developing Microfluidic Double Emulsion Droplet Maker and Magnetic-based Sorter for Superferromagnetic Iron Oxide (SFMIO) Tracers for Magnetic Particle Imaging (MPI)   **Berkeley, CA**, *Sep 2022 – Current*
- Designed and fabricated PDMS-based droplet maker and ferrofluid enhanced sorter to synthesize Oil-Water-Oil droplets containing SFMIOs with a polymerizable biocompatible middle shell to help push MPI's spatial resolution into micron range.
- Conducted precise wettability patterning with aquapel and compressed air and plasma treatment.
- Achieved stable double-emulsion droplets without surfactant in the innermost oleic acid phase.

Exploring Bilateral Symmetry for Parallel-Jaw Grasping   **Berkeley, CA**, *Feb 2022 – May 2022*
- Adapted NeRD, a neural 3D reflection symmetry detector on sim data, to predict symmetry planes on real-world RGBD images.
- Showed a large sim-to-real gap and proposed a refinement procedure through sampling around initial predictions.
- Implemented algorithms to complete the antipodal region of the point cloud and reconstructed 3D meshes for grasp sampling.
- Demonstrated success in physical experiments where classical method failed due to best available grasps being antipodal.

Inner Ear Drug Delivery using Magnetically Directed Synthetic Peptide Hydrogel   **Berkeley, CA,** *March 2022 – May 2022*
- Led a team of 4 to evaluate the feasibility of a needle-injected hydrogel inner ear drug delivery system.
- Built a 3D time-dependent COMSOL molecular transport model using anatomies of the cochlea. Simulated concentration-time profiles for candidates of hydrogels and metal nanoparticles to compare their effective time and toxicity levels.

Turtle Bot Astro with Following and Searching Capability   **Berkeley, CA**, *Oct 2021 – Dec 2021*
- Built a PID-controlled following module with pointcloud-based object avoidance and YOLOv3 based object detection.
- Achieved searching capability with a finite-state machine that transitions among frontier-based exploration, object detection, and object avoidance and target approaching.

SKILLS AND TEST SCORES

- **Programming Languages (with descending proficiency):** Python, MATLAB, Robot Operating System (ROS), C++, Java, R.
- **Software:** AutoCAD, COMSOL, ImageJ, LaTeX, SolidWorks.
- **Skills:** BioMEMS Design and Fabrication, Circuit Design, CNC Fabrication, ELISA, Fluorescence Microscopy, Metallographic Analysis, PCR, Western Blots, 3D printing.

ACTIVITIES

Berkeley Showcase *Volunteer*   **Berkeley, CA**, *Oct.8th*
- Conducted robotics demos for Bay Area/Northern California students who are underrepresented, first generation, or attending an under-resourced school.