Baiyu Shi

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RESEARCH INTERESTS

Diagnostics: Biosensors, BioMEMS, Bioassays, Wearable Devices, and Biophotonics.

Robotics: Robot Learning, Manipulation and Perception, Design of Robotic Systems, and Micro/Nanorobotics.

EDUCATION

University of California, Berkeley   **Berkeley, CA**
B.S. Bioengineering, Electrical Engineering and Computer Science   *September 2019 – Expected May 2023*
- GPA: 3.974/4.00
- Relevant Courses:
  - EECS: Robotics Manipulation and Interaction (A+), Introduction to Robotics (A), Introduction to AI (A+), Introduction to Machine Learning (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 for), Engineering Molecules 1&2 (A+), Biological Transport Phenomena (A+), Biomedical Physiology (A+), Organic Chemistry (A+), BioMEMS and Medical Devices (in Progress)
- Honors & Awards:
  - EECS Honors Program with concentration in biomedical devices.

PREPRINTS

[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.
Under review at the *IEEE International Conference on Robotics and Automation (ICRA)*, 2023.

[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.
Under review at the *IEEE International Conference on Robotics and Automation (ICRA)*, 2023.

RESEARCH EXPERIENCE

Designing and Fabricating Diagnostic Contact Lenses with Antigen Detection Capability   **Berkeley, CA**
Advisor: Prof. Gerard Marriott   *July 2022 – Present*
- Fabricated and compared two kinds of lenses, one based on hydrogel formula using DMAA and NVP and one using PDMS.
- Coated antibodies onto self-made PDMS lenses and commercial lenses (1-day ACUVUE MOIST) with thiol-PEG and HAS-Cy3-Mal, verified with ELISA and fluorescence microscopy.
- Purposed a novel way of patterning multiple antibodies onto a lens with a UV-labile thiol protection group.

[1] AutoBag and [2] Automatic Vascular Shunt Insertion (AVSI)   **Berkeley, CA**
Advisor: Prof. Ken Goldberg   *June 2022 – Present*
[1] 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 self-supervised data collection system that utilizes UV light and fluorescent paint that generates 120 samples per hour.
- Designed and implemented numerous action primitives, including shake, compress, flip, dilate, Pin-Pull etc.
- Modified and trained U-Net architecture to generate segmentation mask predictions for bags with IOU of 77%.
- Proposed the representation of a plastic bag with its opening size and major minor axis ratio.
- Integrated action primitives with perceptions and implemented the Autobag as a finite state machine.

[2] Automatic Vascular Shunt Insertion is an algorithm that estimates the locus of the vessel rim, stretches the rim and performs a chamfer tilt followed with a screw motion to insert the shunt. AVSI achieves more than 80% success rate even with tight tolerances.
- Implemented a self-supervised data collection system with UV light and fluorescent paint that generates 350 samples per hour.
- Found a feasible budget vessel phantom that mimics the size and elasticity of the aorta.
- Based on perception module, implemented PID-based visual servoing to combat inaccuracies caused by cable-driven systems.

Neuromechanics Analysis of Dynamic Ground Righting Maneuvers in Lizards   **Berkeley, CA**
Advisor: Prof. Robert J. Full   *June 2021 – Present*

- Aims at recovering underlying templates for three modes of lizard righting behavior, tail-contact, tail-no-contact and taildrop through high-speed camera recorded trials.
- Trained Resnet50 CNNs (with DEEPLABCUT) on 2,500 fully annotated frames for pose estimation.
- Developed a pipeline for extracting poses from lizard videos that involves (Viterbi, Butterworth, etc.) filters for CNN generated labels, a GUI for inspecting and correcting frames with low confidence, and scripts to reconstruct 3D poses using DLT method. The pipeline provides equal accuracy as complete human labeling but reduces manual labor by a factor of 6.
- Conducted kinematics analysis on tail-contact, tail-no-contact and taildrop righting trials to compare efficiency in three cases.

TEACHING EXPERIENCE

BioE 163 Principles of Molecular and Cellular Biophotonics   **Berkeley, CA**
Role: Graduate Student Instructor (GSI)   *Aug 2022 – Present*

- Lead weekly discussions of 30 students covering lecture contents, self-drafted worksheets, and relevant publications.
- Draft and grade assignments on Gradescope.
- Helped setup course website and answer students' questions on Ed Discussion/ Piazza.

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

PROFESSORIONAL SERVICE

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

PROJECTS

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 that samples around the initial prediction and picks the plane scoring the highest with our symmetry plane evaluation metrics.
- Coded scripts that completed 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.

Turtle Bot Astro with Following and Searching Capability   **Berkeley, CA**, *Oct 2021 – Dec 2021*

- Led a team of 3 to equip a turtle bot 2 with following and searching capability using the Kinect and RGB cameras on board.
- Built a PID-controlled following module that achieved object avoidance module with Kinect-produced point cloud and an object and object detection using the YOLOv3 model.
- Achieved searching capability with a finite-state machine that transitions among exploring state doing frontier-based exploration, searching state doing object detection and spinning, and goal state doing object avoidance and target approaching.

A New Method of 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 to replace the conventional method that may puncture the cochlear membrane or fail to maintain the effective concentration.
- Built a 3D time dependent COMSOL molecular transport model using previous anatomies of the cochlea.
- Simulated concentration-time profile for different candidates of hydrogels and metal nanoparticles to compare their effective time and toxicity levels, and found a feasible pair, RAD16II peptide with iron oxide.

SKILLS AND TEST SCORES

- **Programming Languages (with descending proficiency):** Python, MATLAB, Robot Operating System (ROS), Java, C++, R
- **Software:** LaTeX, COMSOL, AutoCAD, Excel, Gradescope
- **Skills:** PCR, ELISA, Fluorescence Microscopy, Western Blots, BioMEMS Design and Fabrication, Circuits
- **GRE:** Verbal - 162; Quantitative – 170

ACTIVITIES

Bilibili.com *Volunteer Translator*   **Shanghai, China/Berkeley, CA**, *May 2018 – Present*

- Helped translate more than 10 episodes of the Canadian produced documentary *Air Crash Investigation* into Chinese, including S22E05 Pacific Plunge, S12E13 Vanished, etc.