



ENGINEERING PORTFOLIO

by RIAN BORAH

Robotics, Embedded Systems, Computer Architecture, Medical Devices
rianborah@gmail.com

September 2024



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ABOUT ME

EDUCATION

B.S. in Computer Engineering
University of California, Santa Cruz
Concentration: Digital Hardware

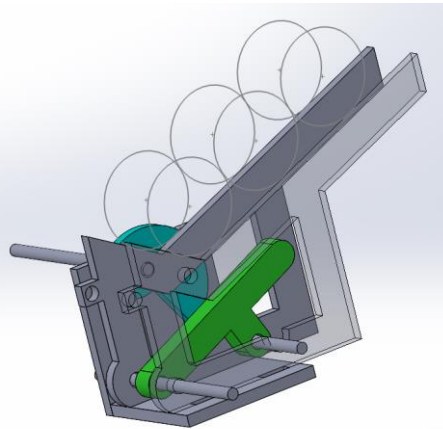
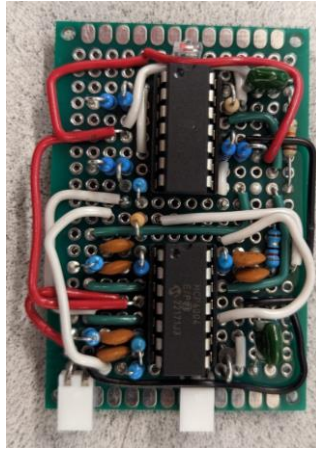
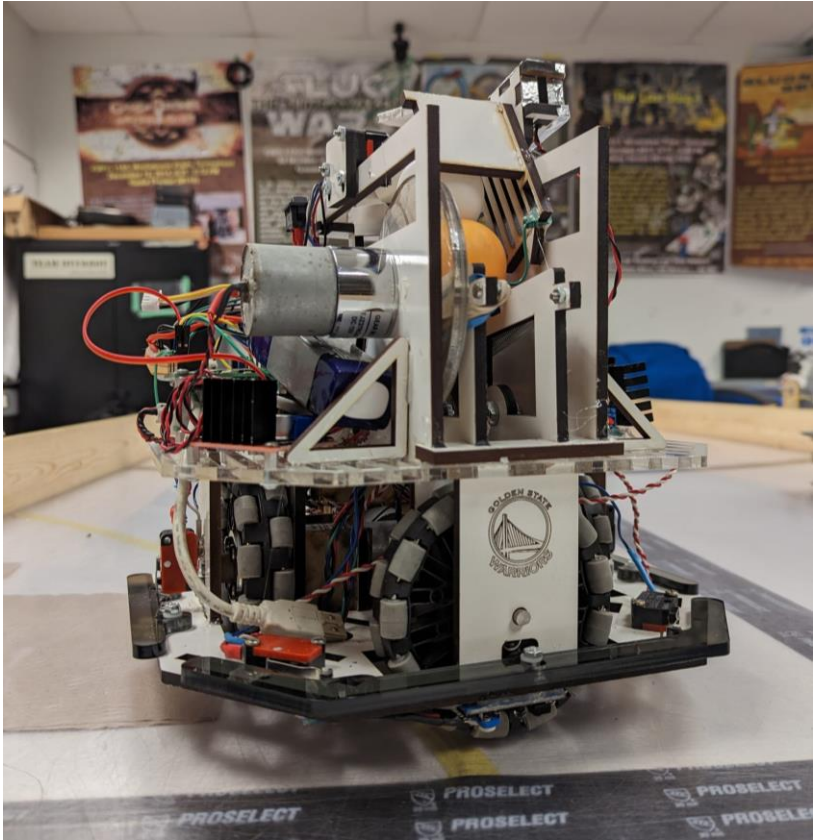
September 2021 - March 2024
(completed in 2.5 years)

ACHIEVEMENTS

Dean's List & Dean's Scholarship worth \$30,000
Stanford SERGE Scholar 2022
Meta ABCS Fellowship 2022



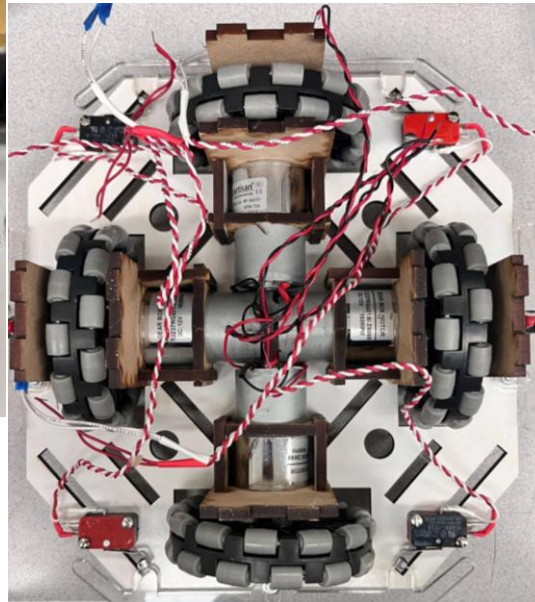
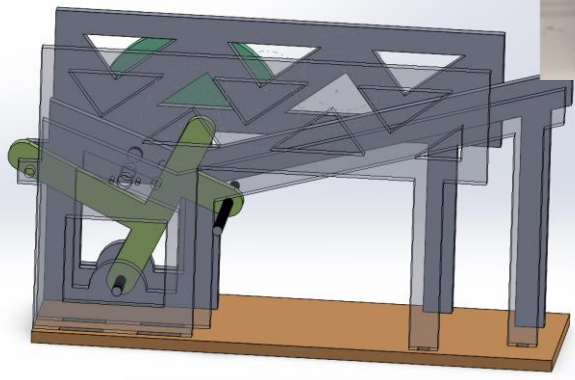
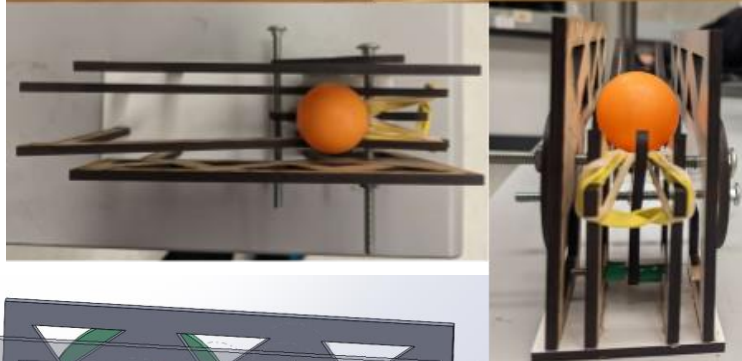
AUTONOMOUS SOCCER ROBOT



Mechatronics Capstone Project

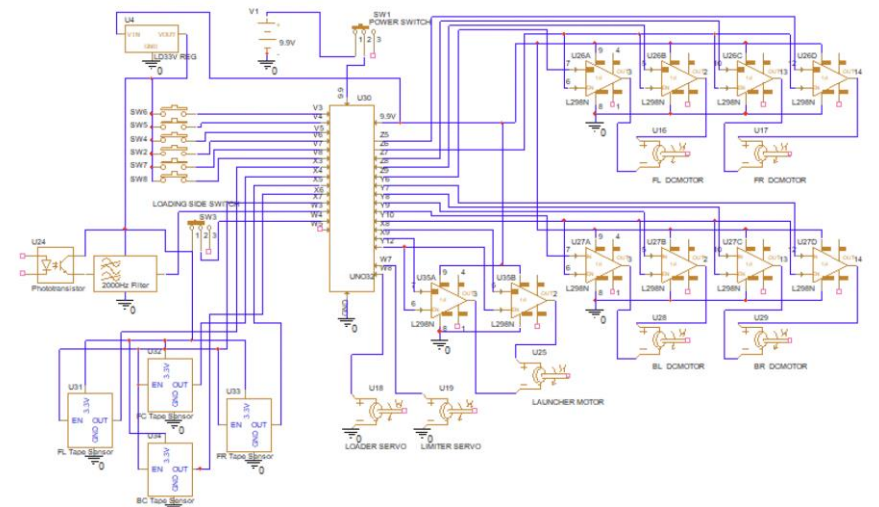
- Fully autonomous robot, able to navigate a replica soccer field and shoot ping-pong balls at an active goalkeeper.
- Running custom event-driven scheduler / RTOS on a PIC32 MCU
- Designed and built IR detection modules using phototransistors, Chebyshev filters, & ADC modules to detect signals from 12ft.

AUTONOMOUS SOCCER ROBOT

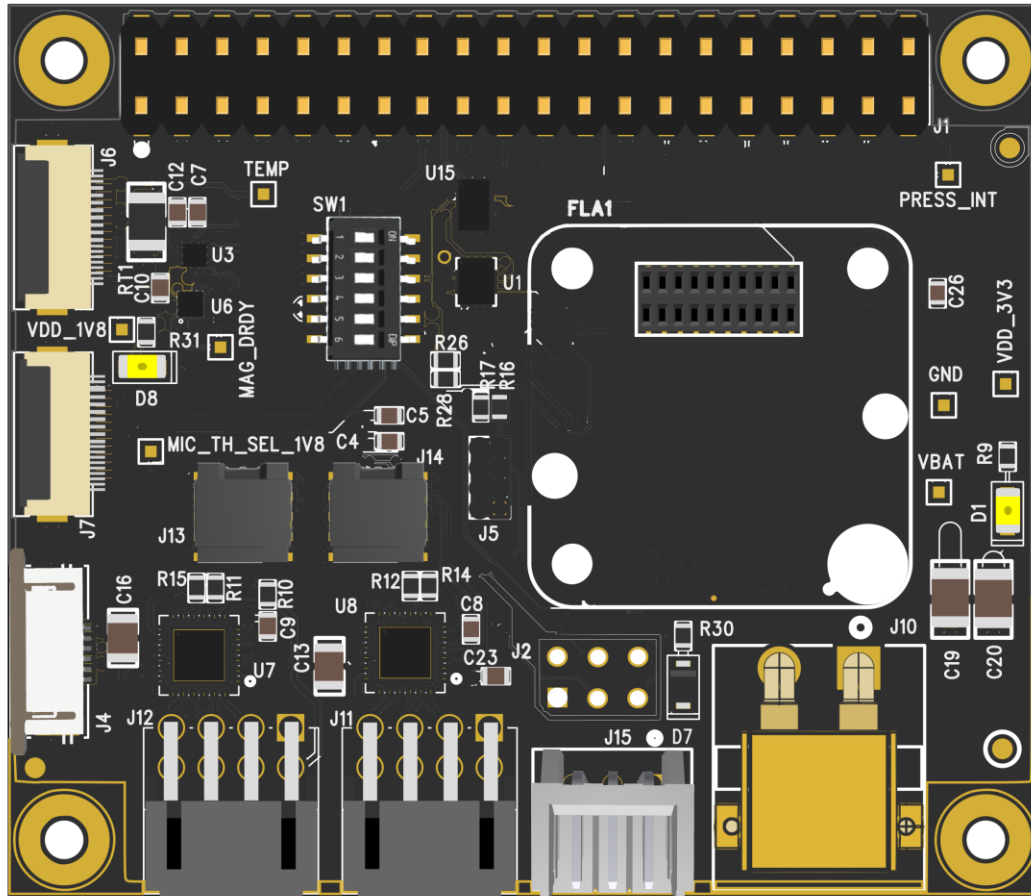


Mechatronics Capstone Project

- Omni-wheel drivetrain for free XY motion
- Designed cam-snail shooter for dynamic shooting range accuracy (3, 6, 9ft)

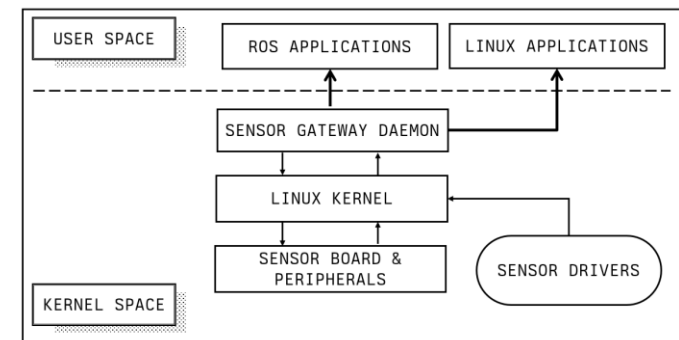


ROBOKIT-LITE BOARD & DRIVERS

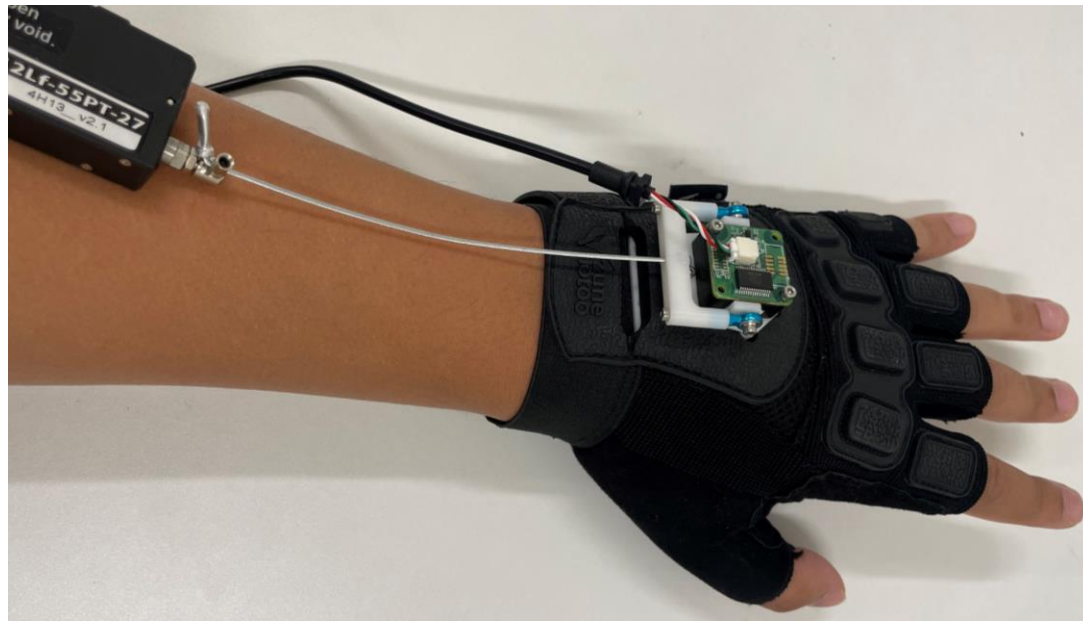


Sensor suite development board @ TDK InvenSense

- Responsible for board bring-up, testing, validation, and documentation
- Wrote kernel driver code for high-speed sensor communication & bulk processing



HAPTIC / BILATERAL TELEOPERATION SYSTEM



A haptic system to counter tremors in patients with Essential Tremors / Parkinsons

Detection system

- Tremor detection using industrial IMU and custom UART communication board
- Arm pose estimation by implementing complementary filter



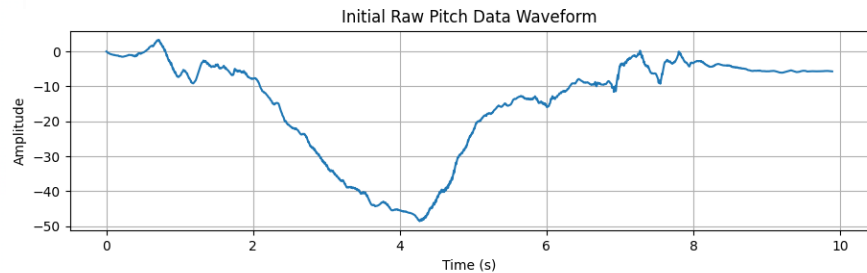
Industrial IMU



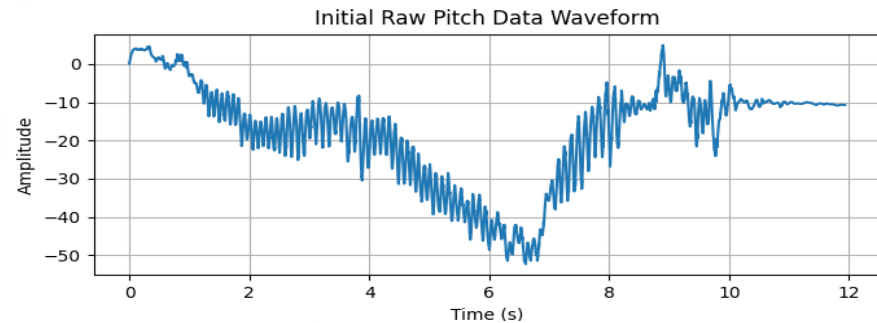
Custom CbM Module

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HAPTIC / BILATERAL TELEOPERATION SYSTEM



Regular arm movement

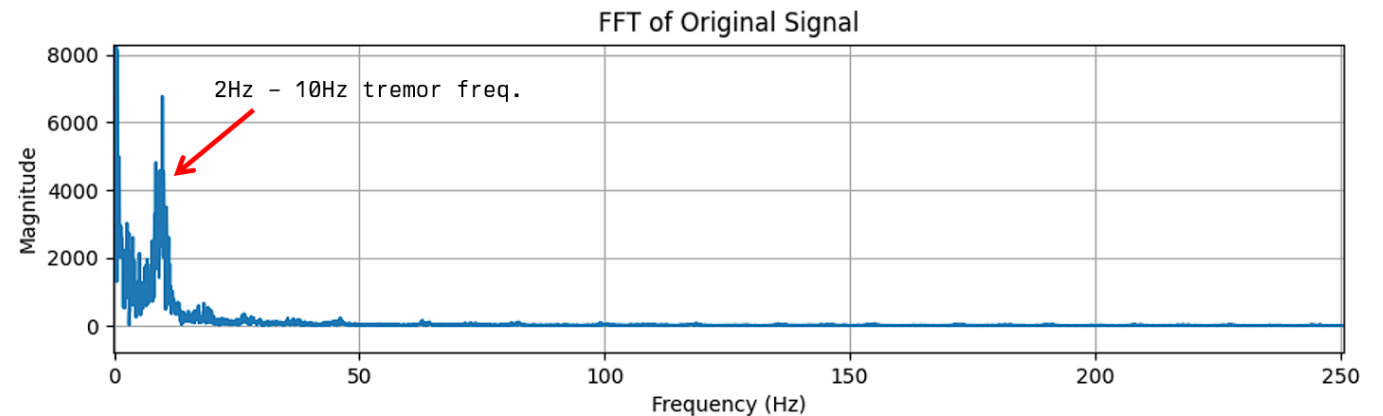


Arm movement with tremors

A haptic system to counter tremors in patients with Essential Tremors / Parkinsons

Detection system

- Vibrational Analysis to isolate tremor frequencies
- Wrote DSP and control system algorithms for motion scaling and impedance control



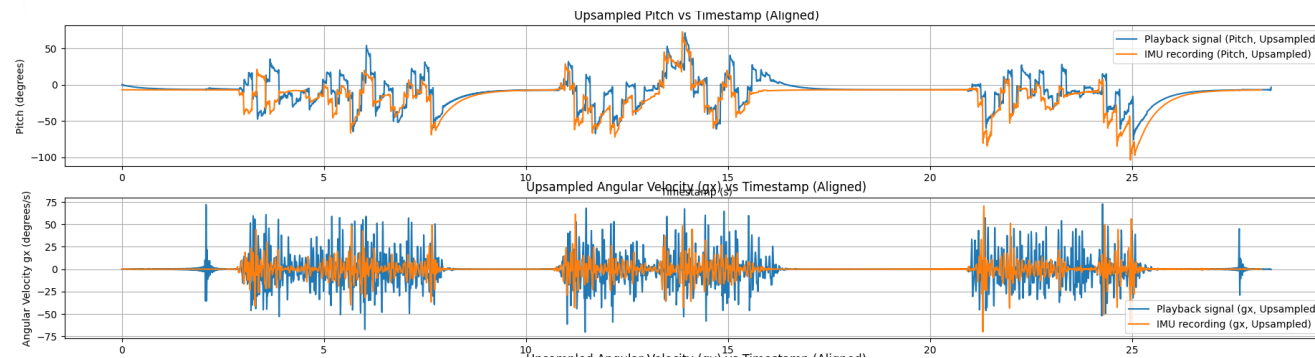
HAPTIC / BILATERAL TELEOPERATION SYSTEM



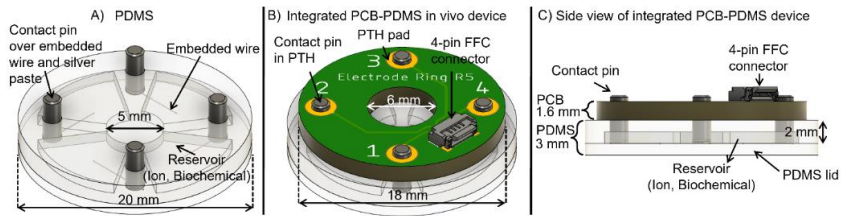
A haptic system to counter tremors in patients with Essential Tremors / Parkinsons

Force feedback system

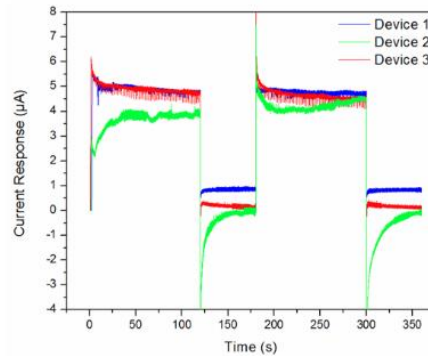
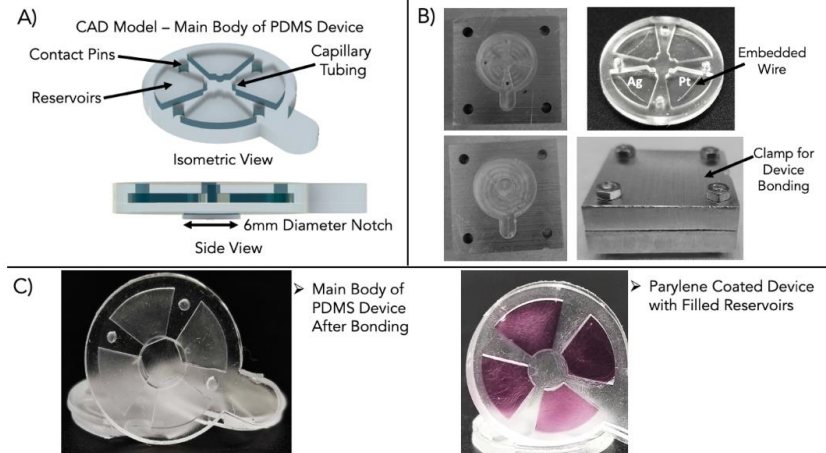
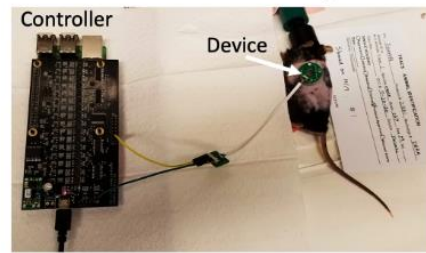
- Master-follower system using dual spring-balanced exciters to generate tremor frequencies
- Designed mechanism for displacement multiplication and testing environment for counterforce device



BIOELECTRONICS - RESEARCH



B) In Vivo K⁺ Delivery

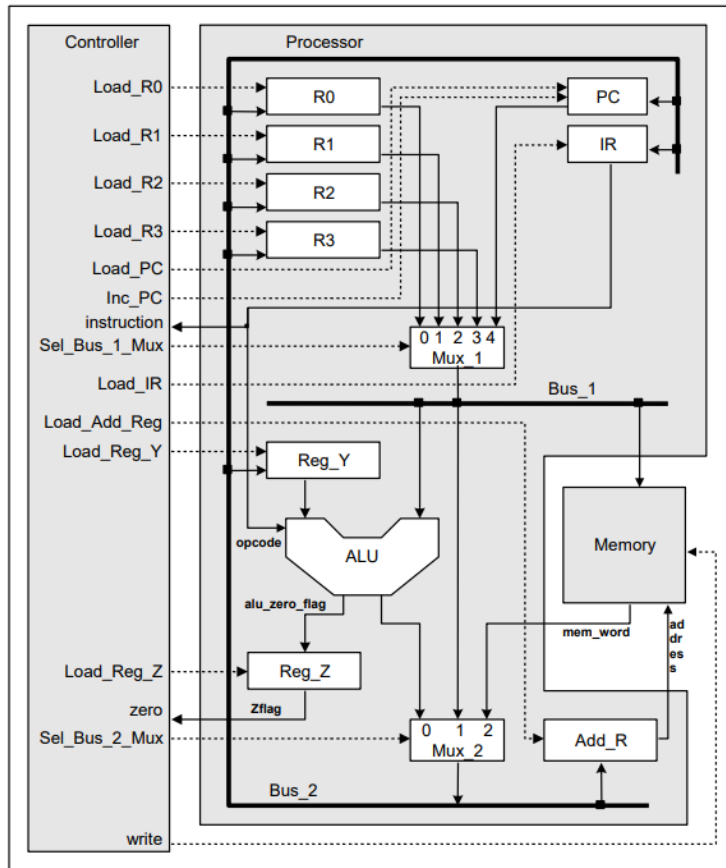


Rolandi Bioelectronics Lab

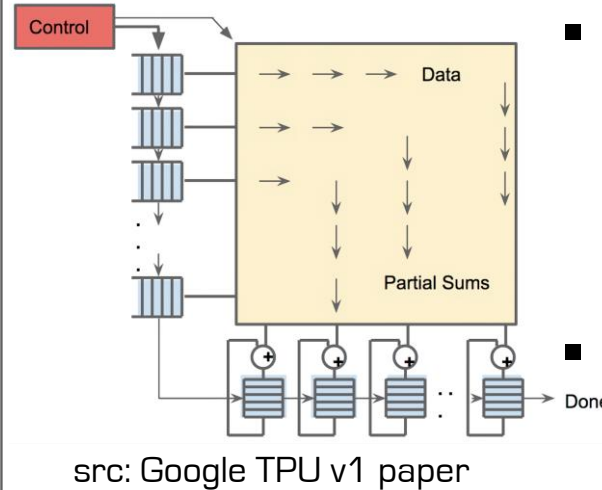
- Fabricated devices for Bioelectronic Intelligent Control for Wound Regeneration under the DARPA-BETR project
- Developing on-chip ion pumps using polydimethylsiloxane (PDMS) and Stereolithography (SLA) 3D printed molds.
- Achieved closed-loop, in-vitro delivery of K⁺ ions, and intelligent control of electrochemical cell membrane potentials.

Approved for public release

COMPUTER ARCHITECTURE - PROJECTS



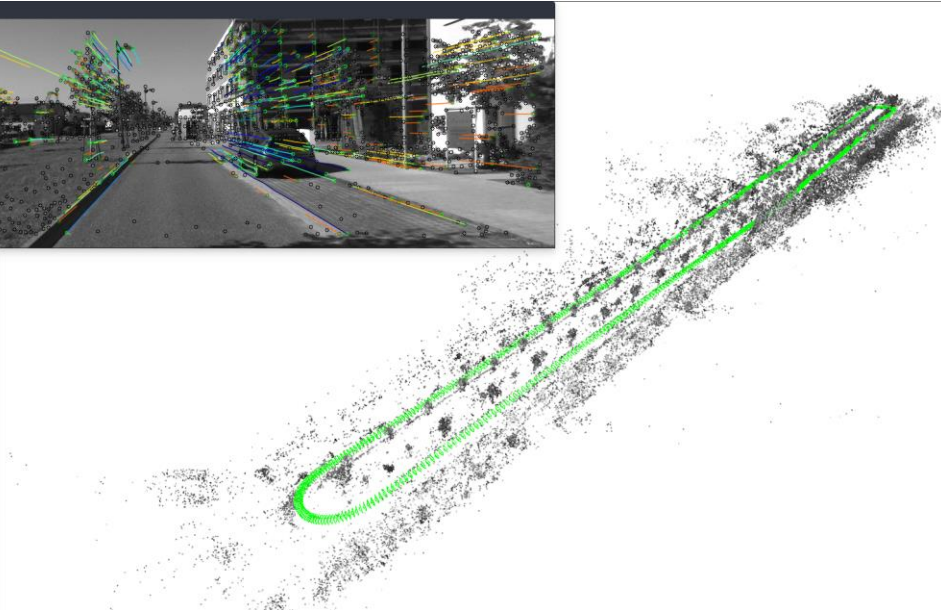
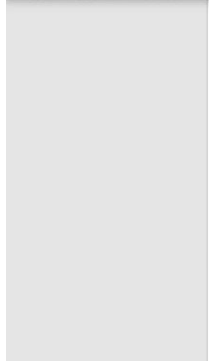
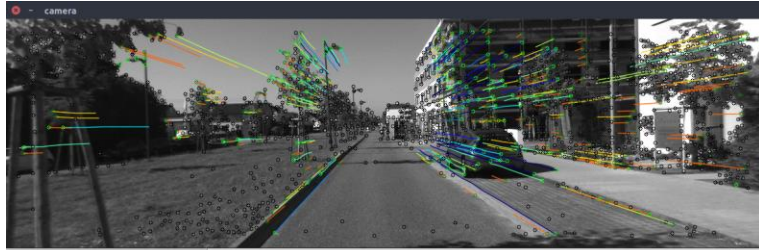
RISC SPM



Experience in SystemVerilog and Chisel HDL

- Systolic DNN/MatMul Accelerator:**
 Designed a parametric systolic array generator for accelerated matrix multiplication (Google TPU)
- RISC Stored Program Machine:**
 Processor, control & memory units
- TensorFlow Lite 2D Convolution Accelerator:**
 Deployed a VexRISCV softcore with a hardware accelerator to reduce instruction cycles for person detection model by 80%

COMPUTER ARCHITECTURE - RESEARCH



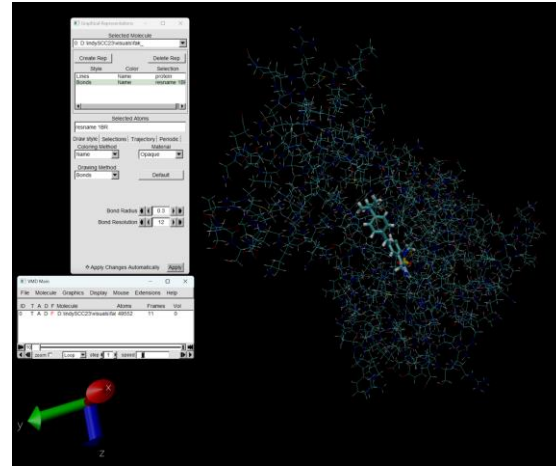
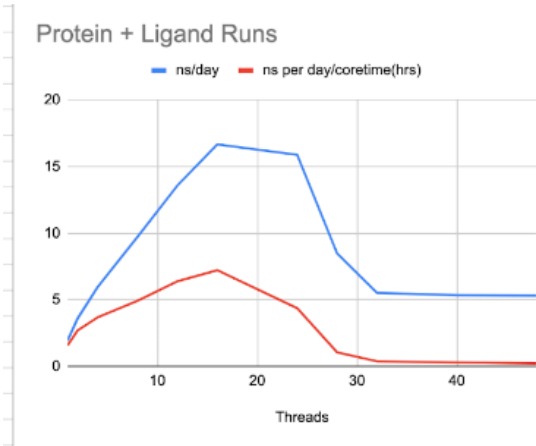
Research: HammerBlade: SLAM Acceleration

- HammerBlade is an ML-optimized RISC-V manycore processor
- Developed code for Simultaneous Localization and Mapping (SLAM) to benchmark architecture performance on large general-purpose workloads

Teaching: 2x Course assistant for CSE 120: Computer Architecture (RISC-V)

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SOFTWARE



High Performance Computing (HPC)

- Competed in IndySCC at SuperComputing '23
- Molecular dynamics simulations on GROMACS, weather simulations on CESM, and graphics rendering on Intel OSPRay.
- Nvidia CUDA, SLURM and OpenMPI to parallelize tasks across hundreds of cluster nodes.

6502 Emulator:

- Created a C++ emulator for the MOS 6502 microprocessor. Cycle-accurate instruction execution and memory interaction simulations.

SyncQ:

- Shipped 3 client-facing features integrating Salesforce, Intuit QuickBooks
- REST APIs, industry best-practices, OAuth2.0, systems & database architecture for enterprise.

OTHER FUN STUFF

- Reverse-engineering electronics
- Decapping ICs
- Building electric guitar effects pedals



- Was also President of my university's Entrepreneurship club
- Led university's team to Venture Capital Investment Competition (VCIC) to US West Regionals at BYU