

Jianwei Sun

Curriculum Vitae

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Education

- 2020 to 2024 **Ph.D. in Mechanical Engineering (Systems and Control)**,
University of California, Los Angeles (UCLA).
Advised by Prof. Dr. Jacob Rosen
- 2019 to 2020 **M.Sc. in Mechanical Engineering (Systems and Control)**,
University of California, Los Angeles (UCLA).
Cumulative GPA: 4.0/4.0
- 2017 to 2019 **M.Sc. in Electrical Engineering and Information Technology**,
Swiss Federal Institute of Technology (ETH Zürich).
Cumulative GPA: 5.71/6.0
- 2012 to 2017 **B.A.Sc. in Engineering Science (Electrical and Computer Engineering)**,
University of Toronto (UofT).
Cumulative GPA: 3.79/4.0

Research Experience

- Feb 2019 to Mar 2024 **Bionics Lab**, University of California Los Angeles.
“Control, Safety, and Estimation in Physical Human-Robot Interaction with Exoskeleton Robots”
Supervised by Prof. Dr. Jacob Rosen.
- Developed an open-source safety-focused admittance control library (including multi-arm collision avoidance) for physical human-robot interaction with real-time collision avoidance (QP solved online) (C/C++) ([GitHub](#))
 - Investigated holonomically constrained admittance control using feedback linearization for robot-assisted rehabilitation (C/C++)
 - Implemented a feedback linearization-based joint-space controller with symbolic dynamics for a Harmonic drive and brushless DC-actuated exoskeleton (C/C++)
 - Implemented a rate-limiting filter to suppress unstable human-induced oscillations due to physiological and mechanical time delays (C/C++)
- Feb 2019 to Sep 2019 **Bionics Lab**, University of California Los Angeles.
“Improving Transparency in Physical Human-Robot Interaction for the EXO-UL8 Exoskeleton”
Project co-supervised by Prof. Dr. Jacob Rosen and Prof. Dr. Maryam Kamgarpour.
- Developed a Kalman filter-based sensor fusion method to achieve similar human-exoskeleton transparency using only a subset of six-axis force/torque sensors (C/C++)
 - Coauthored a paper for the 2019 IEEE International Conference on Rehabilitation Robotics

- Feb 2018 to **Institute for Dynamic Systems and Control**, ETH Zürich.
 Aug 2018 *"Vehicle Platoon Control with Virtual Path Constraints"*
 Project co-supervised by Rajan Gill and Prof. Dr. Raffaello D'Andrea.
 - Designed and implemented a distributed feedback-linearized admittance controller to enable safe physical human-robot interaction with a path-stabilized quadrotor platoon using transverse feedback linearization (C/C++)
 - Primary author of a paper submitted to the 2019 IEEE Conference on Control Technology and Applications, awarded Outstanding Paper Award and finalist for Best Student Paper
- Oct 2017 to **Computer Engineering and Networks Laboratory**, ETH Zürich.
 Feb 2018 *"DCF77 Based Long-Term Timer"*
 Project co-supervised by Roman Trüb and Prof. Dr. Lothar Thiele.
 - Designed and implemented a radio clock-based ultra low power ($\sim 10\mu W$) clock synchronizer capable of overcoming arbitrarily long clock drift for wireless network devices (MSP430, C)
 - Developed a benchmark device based on received timepulses from GPS for characterizing the timer device to nanosecond precision (MSP430, Raspberry Pi, C, Python)
- Sep 2016 to **Reconfigurable Antenna Laboratory**, University of Toronto.
 Jun 2017 *"Synthesis of a Multibeam Dual Reflectarray Beam Pattern Using Genetic Algorithms"*
 Project supervised by Prof. Dr. Sean V. Hum.
 - Developed a genetic algorithm-based multi-objective non-convex optimizer for beam synthesis on a Cassegrain reflectarray antenna system (MATLAB)
 - Coauthored a paper for the 2017 IEEE Antennas and Propagation Symposium
- May 2016 to **Institute for Dynamic Systems and Control**, ETH Zürich.
 Aug 2016 Project co-supervised by Rajan Gill and Prof. Dr. Raffaello D'Andrea.
 - Developed toolchains for automatic dynamic response characterization of nonlinear brushless DC motors for quadrotor vehicles (C/C++, MATLAB)
 - Developed a motor selection tool to automatically scrape off-the-shelf motor data from the web and suggest the best suited based on dynamic response requirements (Ruby)
- May 2014 to **Department of Mechanical Engineering**, National University of Singapore.
 Aug 2014 Project co-supervised by Goh Yu Feng and Prof. Dr. Koh Soo Jin Adrian.
 - Characterized dynamic responses of dielectric elastomers as soft actuators for use as artificial muscles (MATLAB)
 - Developed a waveform generator for a 5kV high voltage power supply to actuate elastomers (LabVIEW)

Work Experience

- Jun 2022 to **Skydio, Autonomy**, San Mateo.
 Sep 2022
 - Evaluated feasibility of a quadrotor emergency three-rotor landing
 - Implemented an IMU-based reduced-attitude controller to stabilize relaxed hover solutions (C++, Python)
 - Tested dynamically feasible optimal braking and landing polynomial trajectories (C++, Python)

- Sep 2018 to **Apple**, *Wearable Systems*, Cupertino.
- Feb 2019
- Designed a drop-in replacement system-in-package for the Apple Watch to measure RF coexistence issues only quantifiable in system form-factor (Cadence)
 - Developed software toolchain to automatically extract, process, and present data from the Apple Watch (Python)
 - Developed experiment setup to investigate a critical system coexistence issue between a power management IC and a MEMS sensor
- Jun 2017 to **Intel**, *Programmable Solutions Group*, San Jose.
- Sep 2017
- Developed hardware interfaces based on Avalon-Streaming for an H.265/HEVC 4K video encoder on a PCIe accelerator card with the Intel Arria-10 FPGA (Verlog, VHDL)
 - Simulated and debugged hardware with ModelSim, VCS-MX simulators, and custom test scripts (Python)
- May 2015 to **Apple**, *Wearable Systems*, Cupertino.
- May 2016
- Designed a multi-purpose hardware validation platform, including schematic entry, component selection, and PCB routing (Cadence)
 - Developed a fault-tolerant software API for a microprocessor to continuously stress-test (for 500 hours) sensors subject to unpredictable device and digital interface failures in a high temperature/humidity environment (MSP432, C/C++)
 - Successfully identified a rare reliability failure mode and aided cross-functional teams in arriving at a mass-producible solution

Publications

- [JP4] **J. Sun**, Y. Foroutani, J. Rosen, "Virtually Constrained Admittance Control using Feedback Linearization for Physical Human-Robot Interaction with Rehabilitation Exoskeletons." Under review.
- [JP3] P. W. Ferguson, **J. Sun** and J. Rosen, "On the OTHER Hand: A Bilateral, Re-configurable Hand Exoskeleton with Opposable Thumbs for Use with Upper Limb Exoskeletons," in *Transactions on Medical Robotics and Bionics (TMRB)*, 2024. Accepted.
- [JP2] **J. Sun**, E. H. Kramer, J. Rosen, "A Safety-Focused Admittance Control Approach for Physical Human-Robot Interaction with Rigid Multi-Arm Serial Link Exoskeletons," in *Transactions on Mechatronics (TMECH)*, 2024. Accepted. [Video](#).
- [JP1] **J. Sun**, Y. Shen, J. Rosen, "Sensor Reduction, Estimation, and Control of an Upper-Limb Exoskeleton," in *IEEE Robotics and Automation Letters (RA-L)*, vol. 6, no. 2, pp. 1012-1019, April 2021, doi: 10.1109/LRA.2021.3056366.
- [CP4] **J. Sun**, P. W. Ferguson and J. Rosen, "Suppressing Delay-Induced Oscillations in Physical Human-Robot Interaction with an Upper-Limb Exoskeleton using Rate-Limiting," *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Kyoto, Japan, 2022, pp. 6695-6701, doi: 10.1109/IROS47612.2022.9981943. [Video](#).

- [CP3] Y. Shen, **J. Sun**, J. Ma, J. Rosen, "Admittance Control Scheme Comparison of EXO-UL8: A Dual-Arm Exoskeleton Robotic System," *2019 IEEE 16th International Conference on Rehabilitation Robotics (ICORR)*, Toronto, ON, Canada, 2019, pp. 611-617, doi: 10.1109/ICORR.2019.8779545.
- [CP2] **J. Sun** and R. Gill, "Vehicle Platoon Control with Virtual Path Constraints," *2019 IEEE Conference on Control Technology and Applications (CCTA)*, Hong Kong, China, 2019, pp. 456-461, doi: 10.1109/CCTA.2019.8920555. [Video](#).
- [CP1] C. Geaney, **J. Sun**, S. V. Hum, E. Martinez-de-Rioja, and J. A. Encinar, "Synthesis of a multi-beam dual reflectarray antenna using genetic algorithms," *2017 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting (AP-S/URSI)*, San Diego, CA, USA, 2017, pp. 1179-1180, doi: 10.1109/APUSNCURSINRSM.2017.8072632.

Service

Ad-hoc Reviewer Transactions on Robotics (T-RO), Transactions on Mechatronics (TMECH), Transactions on Medical Robotics and Bionics (T-MRB), Robotics and Automation Letters (RA-L), Control System Letters (L-CSS), International Conference on Robotics and Automation (ICRA), International Conference on Intelligent Robots and Systems (IROS), Conference on Decision and Control (CDC)

Awards

- 2023 Outstanding TA Award, Mechanical and Aerospace Engineering, University of California, Los Angeles
- 2022 Mechanical and Aerospace Engineering Department Fellowship, University of California, Los Angeles
- 2021 Grad Slam Top 10, University of California, Los Angeles.
- 2019 Best Student Paper Finalist, Outstanding Paper Award, 3rd IEEE Conference on Control Technology and Applications (CCTA).
- 2017 Dean's Honours List, University of Toronto, awarded for all academic years.
- 2016 University of Toronto, Center for International Experience Award, for funding summer research conducted at ETH Zürich.
- 2014 Nortel Institute Undergraduate Scholarship, University of Toronto.
- 2014 University of Toronto, Center for International Experience Award, for funding summer research conducted at the National University of Singapore.
- 2012 President's Scholars of Excellence entrance scholarship, University of Toronto.
- 2012 Alexander Rutherford Scholarship.

Conference Participation

- 2023 2023 Southern California Robotics Symposium (SCR). Participant.
- 2022 35th IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). Podium presentation.
- 2019 16th IEEE/RAS-EMBS International Conference on Rehabilitation Robotics (ICORR). Podium presentation.
- 2019 IEEE/AIM Workshop on "Towards Soft Robotics for Biomimetics and Applications: Emerging Sensors, Actuators, and Methods". Poster.

Teaching and Mentoring Experience

- Jan 2024 to Apr 2024 **Teaching Fellow**, MECH&AE M20 - Introduction to Computer Programming with MATLAB, University of California Los Angeles (Winter Quarter).
20 hours per week
- Sep 2023 to Dec 2023 **Teaching Fellow**, ENGR 214 - Management Communication, University of California Los Angeles (Fall Quarter).
20 hours per week
- Apr 2022 to Jun 2022 **Teaching Fellow**, LIFESCI 30B - Mathematics for Life Scientists (Python), University of California Los Angeles (Spring Quarter).
20 hours per week
- Jan 2022 to Apr 2022 **Teaching Fellow**, LIFESCI 30B - Mathematics for Life Scientists (Python), University of California Los Angeles (Winter Quarter).
20 hours per week
- Sep 2021 to Dec 2021 **Teaching Fellow (Head TA)**, MECH&AE M20 - Introduction to Computer Programming with MATLAB, University of California Los Angeles (Fall Quarter).
20 hours per week
- Apr 2021 to Jun 2021 **Teaching Associate**, EC ENGR 141 - Principles of Feedback Control, University of California Los Angeles (Spring Quarter).
20 hours per week
- Jan 2021 to Apr 2021 **Teaching Associate**, LIFESCI 30B - Mathematics for Life Scientists (Python), University of California Los Angeles (Winter Quarter).
20 hours per week
- Sep 2020 to Dec 2020 **Teaching Associate (Head TA)**, MECH&AE M20 - Introduction to Computer Programming with MATLAB, University of California Los Angeles (Fall Quarter).
20 hours per week
- Apr 2020 to Jun 2020 **Teaching Assistant**, LIFESCI 30B - Mathematics for Life Scientists (Python), University of California Los Angeles (Spring Quarter).
20 hours per week

- Jan 2020 to Apr 2020 **Teaching Assistant**, LIFESCI 30B - Mathematics for Life Scientists (Python), University of California Los Angeles (Winter Quarter).
20 hours per week
- Sep 2019 to Dec 2019 **Teaching Assistant**, MECH&AE M20 - Introduction to Computer Programming with MATLAB, University of California Los Angeles (Fall Quarter).
20 hours per week
- Aug 2016 to Jun 2017 **Mentor**, IEEE Student Branch, University of Toronto.
10 hours per week
- Mentored first and second year engineering students in hands-on electronics, design, and debugging (Arduino, C/C++)

Volunteering Experience

- Aug 2016 to Jun 2017 **Director of Events**, IEEE Student Branch, University of Toronto.
10 hours per week
- Headed logistics and operations for a hardware Hackathon event with focus on wireless embedded technologies, resulting the largest participant turnout in recent years
 - Negotiated with suppliers and sponsors to ensure sufficient funding for the club's operations
- 2013 to 2014 **Volunteer Team Member**, Supermileage Club, University of Toronto.
5 hours per week
- Designed the fuel pressurization system and engine dynamometer
 - Assisted in carbon fiber layups, development, and assembly of completely new vehicle
- 2011 to 2013 **Volunteer**, Telus Spark Science Center, Calgary.
5 hours per week
- 2010 to 2011 **Volunteer**, Canadian Red Cross, Calgary.
5 hours per week

Personal Projects

Banana Split, Split-style ergonomic mechanical keyboard.

- Designed single PCB for both left and right sides in Altium
- Designed enclosure in SolidWorks and 3D printed

[Link](#) **Website**, Personal website developed with Jekyll.

[Github](#) **HarryPlotter**, open source plotting library for MATLAB.

[Video](#) **Boomerang**, persistence of vision display.

- Implemented a dynamic self-calibrating algorithm to calculate frame flashing rates of LEDs in a high-RPM rotating display

Technical Skills

Software

Languages C/C++, Python, MATLAB, L^AT_EX, {x86_64, ARM, PIC} assembly, Java, Ruby, Bash
Environments Linux, Windows, Qt, LabVIEW, Jekyll, Ruby on Rails, Flask
Tools Eigen, Boost, Git, CMake, Make, Ninja, PREEMPT_RT

Hardware

Embedded ATmega, MSP43x, PIC, STM32, {Cyclone, Arria 10} FPGA, Arduino, Raspberry Pi
Lab Oscilloscopes, function generators, DC power supplies, DMMs, LCR meters, vector network analyzers, spectrum analyzers, logic analyzers, frequency counters
Soldering Hands-on experience with DIP, SMT down to 01005, BGA, LGA, QFP packages

Tools

Simulation MuJoCo, MATLAB, Simulink, PSpice, LTSpice, ModelSim, VCS-MX
Design Cadence, Altium, KiCad, Eagle, SolidWorks

Languages

Native English
Native Mandarin Chinese
Intermediate German
Basic French

Hobbies

Boxing
Mountain biking
Hiking