

Levi “Veevee” Cai

Education

- Massachusetts Institute of Technology and Woods Hole Oceanographic Institution** *June 2019 to Present*
Graduate Student in Applied Ocean Science and Engineering & Electrical Engineering and Computer Science
Advised by Dr. Yogesh Girdhar (WHOI), collaborate with Prof. Daniela Rus (MIT)
- University of Washington** *Sept. 2018 to June 2019*
Research Assistant in Aeronautics and Astronautics
Co-advised by Prof. Kristi Morgansen and Dr. Sarah Webster (UW APL)
- Massachusetts Institute of Technology** *May 2016 to May 2018*
Master of Science in Media Arts and Sciences, GPA: 5.0/5.0
Thesis, advised by Prof. Neri Oxman: “On-site Autonomous Fabrication at Architectural Scales”
- University of Pennsylvania** *Sept. 2008 to Dec. 2015*
Master of Science in Engineering in Robotics, 2015, GPA: 3.94/4.0
Bachelor of Science in Engineering in Computer Science, Minor in Mathematics, 2012, GPA: 3.35/4.0

Research

- Massachusetts Institute of Technology and Woods Hole Oceanographic Institution** *2018 to Present*
Advised by Dr. Yogesh Girdhar (WHOI), collaborate with Prof. Daniela Rus (MIT)
- Researching semi-supervised machine learning, controls, and vision-based methods for marine animal tracking using autonomous underwater vehicles, with a particular focus on scenarios with little or no labelled data. Extensive field work and diving.
 - Developing algorithms for vision-based control of multi-robot systems on soft robotic fish.
 - Working with biologists to develop various vision and machine learning models to assist in understanding biodiversity and animal behavior in coral reef and coastal environments.
- University of Washington** *Fall 2018 to 2019*
Advised by Prof. Kristi Morgansen (UW Aero&Astro) and Dr. Sarah Webster (UW APL), Graduate Researcher
- Studied automated tuning strategies for Kalman filters used on UW Seaglidors.
- MIT Media Lab, Mediated Matter Group** *May 2016 to 2018*
Advised by Prof. Neri Oxman, Graduate Research Assistant
- Designed controls, simulation, and software architecture for large-scale, mobile, autonomous robotic platform used for construction. Performed real-world demonstration of system by printing 14.6m diameter half-dome. Supported by *Alphabet’s X (formerly Google [x])*.
 - Developed electronics, software, and controls for swarm-based robots that fabricate tubular fiberglass structures, experimentally verified by creating 20 robots, each autonomously built structures that were 4-meters tall.
- Univ. of Pennsylvania, GRASP Lab** *2009 to 2015*
Advised by Prof. Daniel Lee and Prof. Mark Yim, Graduate Research Assistant
- Developed a provably optimal algorithm for any-angle path planning by applying a novel overestimate heuristic to the Fast Marching Method. Additionally investigated heuristic strategies for multi-robot settings.
 - Developed software for user control of modular robots (CKBots) based on Robotics Bus Protocol.

Publications and Presentations

* Co-first author

Journal Articles

- **Levi Cai**, Nathan E. McGuire, Roger Hanlon, T. Aran Mooney. “Semi-supervised Visual Tracking of Marine Animals using Autonomous Underwater Vehicles.” *International Journal of Computer Vision (IJCV)*, 2023 (to appear). <https://arxiv.org/abs/2302.07344>
- Markus Kayser*, **Levi Cai***, Sara Falcone, Christoph Bader, Nassia Inglessis, Barrak Darweesh, João Costa, Neri Oxman. “FIBERBOTS: An Autonomous Swarm-based Robotics System for Digital Fabrication of Fiber-based Composites.” *Springer Construction Robotics*, Dec. 2018.

- Markus Kayser*, **Levi Cai***, Sara Falcone, Christoph Bader, Nassia Inglessis, Barrak Darweesh, Neri Oxman. "Design of a multi-agent, fiber composite digital fabrication system." *Science Robotics*, Sept. 2018.
- Steven J. Keating, Julian C. Leland, **Levi Cai**, and Neri Oxman. "Toward site-specific and self-sufficient robotic fabrication on architectural scales." *Science Robotics*, Apr. 2017.

Refereed Conference Papers

- Yogesh Girdhar, Nathan McGuire, **Levi Cai**, Stewart Jamieson, Seth McCammon, Brian Claus, John E. San Soucie, Jessica E. Todd, T. Aran Mooney. "CUREE: A Curious Underwater Robot for Ecosystem Exploration." *IEEE International Conference on Robotics and Automation (ICRA)*, 2023 (to appear).
- Juan Salazar, **Levi Cai**, Braden Cook, Daniela Rus. "Multi-Robot Visual Control of Autonomous Soft Robotic Fish." *IEEE/OES Autonomous Underwater Vehicles Symposium (IEEE AUV)*, 2022.
- **Levi Cai***, Burak Boyacıoğlu*, Sarah E. Webster, Kristi Morgansen. "Towards Auto-tuning of Kalman Filters for Underwater Gliders based on Consistency Metrics." *MTS/IEEE OCEANS*, 2019.
- Yogesh Girdhar, **Levi Cai**, Stewart Jamieson, Nathan McGuire, Genevieve Flaspohler, Stefano Suman, Brian Claus. "Enabling Co-Robotic Scientific Exploration of Unknown Environments over a Low Bandwidth Communication Channel." *IEEE International Conference on Robotics and Automation (ICRA)*, 2019.
- Markus Kayser, **Levi Cai**, Christoph Bader, Sara Falcone, Nassia Inglessis, Barrak Darweesh, João Costa, Neri Oxman. "FIBERBOTS: Design and Digital Fabrication of Tubular Structures Using Robot Swarms." *ROBARCH*, Aug. 2018. **KUKA Young Potential Best Paper Award.**

Talks and Presentations

- Levi Cai, Nathan E. McGuire, Roger Hanlon, T. Aran Mooney, Yogesh Girdhar. "Semi-supervised Visual Tracking of Marine Animals in the Wild." *IEEE Computer Vision and Pattern Recognition (CVPR) CV4Animals Workshop*, 2022.
- Levi Cai, Roger Hanlon, Yogesh Girdhar. "Evaluation of Semi-supervised Visual Object Tracking Methods For Fully Autonomous In-situ, Tagless Tracking of Marine Animals." *ASLO Ocean Sciences Meeting (OSM)*, 2022.
- Levi Cai, Roger Hanlon, Yogesh Girdhar. "Evaluation of Semi-supervised Visual Object Tracking Methods For Fully Autonomous In-situ, Tagless Tracking of Marine Animals." *IEEE Computer Vision and Pattern Recognition (CVPR) CV4Animals Workshop*, 2021.
- "WARPAUV: A low-cost, vision-guided AUV for robotics research." Northeast Robotics Colloquium 2019.
- "Digital Construction Platform." Northeast Robotics Colloquium 2017.

Patents

- Markus Kayser, Levi Cai, Sara Falcone, Neri Oxman. "Methods and apparatus for tube fabrication." Patent application, Appl. No. US16/260,149.

Teaching

Univ. of Pennsylvania, Computer Science Dept.

- CIS520, Intro. to Machine Learning, Fall 2015
- CIS521, Intro. to AI, grad-level, Fall 2012

Professional

MasterStreet (startup)
IBM

Software Engineer (New York, NY)
Software Engineer (Durham, NC)

2013 to 2014
2012 to 2013

Fellowships and Awards

Nvidia Hardware Grant Recipient – Awarded an A6000 GPU for research purposes
NDSEG Fellow 2019

Link Ocean Engineering Fellowship 2019 – Declined for NDSEG (4 awarded annually)
UW GSFEI Top Scholar Program - Fellowship awarded to 1 student per department at Univ. of Wash.
KUKA Young Potential Best Paper Award – RobArch 2018 Conference paper
UPenn Rachleff Scholar – Highly-selective undergraduate research program
IBM T. J. Watson Scholarship

Service and Outreach

Robotics: Science and Systems Conference (RSS) 2017 Volunteer
MIT RoboCon Organizer – Helped organize an MIT/Boston-area robotics conference (<http://robocon.mit.edu/>)
IBM Extreme Blue Technical Mentor – Mentored team of engineering undergraduates and an MBA student
FIRST Robotics Mentor – NCSSM Team 900
UPenn Summer Mentorship Program – Full-time instructor for 6-week, high-school summer technology course
FIRST Lego League Coach – FACTS Middle School, afterschool robotics team coach

Leadership and Extracurriculars

UPenn RoboCup SPL Vision	<i>Vision Team Lead</i>	<i>2009 to 2012</i>
UPenn FSAE Race Car	<i>Electrical Team Lead</i>	<i>2010 to 2012</i>

Additional Skills

Programming	Python, C/C++, ROS, CUDA, Java, MATLAB/MEX, Ruby, Full Web Stack
Software	Eagle PCB CAD, SolidWorks, Adobe Illustrator
Other	Certified Scientific Diver