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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.

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 Seagliders.

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).
- 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. ***<u>KUKA Young Potential Best Paper Award.</u>***

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)	*Software Engineer (New York, NY)*	*2013 to 2014*
IBM	*Software Engineer (Durham, NC)*	*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	*Vision Team Lead*	*2009 to 2012*
UPenn FSAE Race Car	*Electrical Team Lead*	*2010 to 2012*

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