Levi "Veevee" Cai

Permanent: 4080 Pinon Dr, Boulder CO, 80303
Email: levi@levicai.com
Web Portfolio: www.levicai.com

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, collaborate with Dr. Dana Yoerger and Prof. Daniela Rus

University of Washington   *Sept. 2018 to June 2019*
  Graduate Student 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

Woods Hole Oceanographic Institution   *2018 to Present*
Advised by Dr. Yogesh Girdhar, collaborate with Dr. Dana Yoerger and Prof. Daniela Rus
- Extended ROST (Realtime Online Spatiotemporal Topic modeling), an algorithm based on hierarchical Dirichlet processes to create "curiosity-driven" learning, to mapping settings. Used on underwater autonomous vehicles for exploring novel environments and classifying regions of interest into topics.
- Developed controls for underwater and surface vehicles, testing infrastructure, and in-tank localization.
- Researching machine learning and vision-based methods for autonomous marine animal tracking.

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 all 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
- Markus Kayser*, <u>Levi Cai</u>*, 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*, <u>Levi Cai</u>*, 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, <u>Levi Cai</u>, and Neri Oxman. "Toward site-specific and self-sufficient robotic fabrication on architectural scales." *Science Robotics*, Apr. 2017.

Conference Proceedings
- Charles Xu*, <u>Levi Cai*</u>, Yogesh Girdhar, "[Anonymized]." *IEEE Computer Vision and Pattern Recognition (CVPR), 2022*. [In review]
- <u>Levi Cai</u>*, Burak Boyacıoğlu*, Sarah E. Webster, Kristi Morgansen. "Towards Auto-tuning of Kalman Filters for Underwater Gliders based on Consistency Metrics." *OCEANS MTS/IEEE*, 2019.
- Yogesh Girdhar, <u>Levi Cai</u>, 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, <u>Levi Cai</u>, 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, 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. Poster.
- "WARPAUV: A low-cost, vision-guided AUV for robotics research." Northeast Robotics Colloquium 2019. Poster.
- "Digital Construction Platform." Northeast Robotics Colloquium 2017. Poster.
- "Digital Construction Platform." MIT Robocon, 2017. Presentation.

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.
Supervised by Prof. Lyle Ungar, Teaching Assistant
- CIS520, Intro. to Machine Learning, grad-level, created assignments and held office hours, Fall 2015
- CIS521, Intro. to AI, grad-level, created assignments and projects, Fall 2012

Professional

MasterStreet (startup)   *2013 to 2014*
Software Engineer
- Built search engine for professional development classes using Ruby on Rails, ElasticSearch, and AWS

IBM   *2012 to 2013*
Software Engineer
- Developed server management mobile app using Dojo/Cordova for iOS/BB/Android platforms

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   *2009 to 2012*
Vision System Team Lead
- Implemented basic vision algorithms (line and horizon detection), and led small group of undergraduates to improve on vision system for humanoid robot soccer competition (using the Nao platform). Team placed as quarter-finalist/24 teams in 2010 RoboCup SPL competition.

UPenn FSAE Race Car   *2010 to 2012*
Electrical System Team Lead
- Designed and constructed the electrical system for a competitive Formula-style race car, 1 of 4 core members, team placed 18th/108 at the 2011 Formula SAE competition.

Additional Skills

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