Levi Burner — Ph.D. Candidate

University of Maryland, College Park, MD

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Education

University of Maryland — **College Park, MD**

Ph.D. in Electrical and Computer Engineering, GPA: 3.97/4.0 — *2019–Present*
Masters in Electrical Engineering — Fall 2023
Certificate in Computation and Mathematics for Biological Networks — Fall 2022
Advisors: Prof. Yiannis Aloimonos and Dr. Cornelia Fermüller

Selected Coursework: Adaptive, Stochastic, Nonlinear, and Optimal Control; Statistical Pattern Recognition; Random Processes; Computational and Mathematical Analysis for Networks Across Scales

University of Pittsburgh — **Pittsburgh, PA**

B.S. in Electrical Engineering, GPA: 3.82/4.0 — *2014–2018*
Concentration in Communications and Signal Processing

Selected Coursework: Linear Control Systems; Image Processing; Analog and Digital Communications; Intro to Theoretical Math; Honors Linear Algebra

Honors and Awards

- **Maryland Robotics Center Graduate Research Assistantship** — *University of Maryland, Summer 2023 - Spring 2023*
- **Google Open Source Peer Bonus for contributions to MuJoCo** — *Google, April 2023*
- **Outstanding Teaching Assistant Award** — *University of Maryland, ECE, Fall 2022 - Spring 2023*
- **Future Faculty Fellow** — *University of Maryland, Spring 2023–Present*
- **Computation and Mathematics for Biological Networks Fellow** — *University of Maryland, Fall 2020–Spring 2022*
- **Dean's Fellowship** — *University of Maryland, Fall 2019–Spring 2020*
- **Outstanding Graduate in Electrical Engineering** — *University of Pittsburgh, Fall 2018*
- **Swanson School of Engineering Dean's List** — *University of Pittsburgh, Fall 2015–Fall 2018*
- **Most Points, Best System Design, Best Technical Paper** — *IARC American Venue, Georgia Tech, 2018*
- **3rd place in ECE Senior Design** — *Swanson School of Engineering Design Expo, Spring 2018*
- **Most Points, Best System Design** — *IARC American Venue, Georgia Tech, 2017*

Research Interests

Perception and Robotics Group — **University of Maryland**

PhD Proposal: Learning Visuomotor Internal Representations

My dissertation introduces a concept called the Visuomotor Embodiment Principle and an accompanying mathematical framework for robotics. This general principle and associated algorithms allow robots to perform common tasks in a provably stable manner without depending on a source of external scale calibrated to a pre-determined unit such as the meter. This will allow a large class of robots to automatically learn to control themselves using vision as the primary feedback mechanism and without detailed specifications of mechanical configuration. The principle is inspired by certain behaviors in humans, bees, and dragonflies. Specific projects include:

- Vision-based adaptive control of a tailless flapping flying robot using visuomotor embodiment
- Robust flight through moving gaps using visuomotor embodiment
- Independent motion estimation using constrains from learned visuomotor models
- EVIMO3: An Event Camera Dataset with Independently Moving Objects Propelled by Humans

Publications and Technical Reports

Burner, L., Sanket, N. J., Fermüller, C., and Aloimonos, Y. (Sep. 2022). **TTCDist: Fast Distance Estimation From an Active Monocular Camera Using Time-to-Contact**, *Accepted to ICRA 2023.* Link

Burner, L., Mitrokhin, A., Fermüller, C., and Aloimonos, Y. (May, 2022). **EVIMO2: An Event Camera Dataset for Motion Segmentation, Optical Flow, Structure from Motion, and Visual Inertial Odometry in Indoor Scenes with Monocular or Stereo Algorithms**, *ArXiv Technical Report.* Link

Burner, L., (December, 2021). **On Continuous Time Lucas-Kanade Tracking using Lessons from Adaptive Control**, *ENEE765: Adaptive Control Semester Project* Link

Burner, L., (December, 2020). **Optimal Stochastic Control of Linear systems Driven by Neural Dynamics**, *ENEE762: Stochastic Control Semester Project* Link

Miller, A., Burner, L., Becker, E., Misra, R., Saba, A., and Berti, L. (2018). **A Novel UAV for Interaction with Moving Targets in an Indoor Environment.** *IARC Symposium on Indoor Flight Issues.* Link (Won Best Technical Paper)

Burner, L., and Sharma, N. (2018). **A Wearable Sensing System to Estimate Lower Limb State for Drop Foot Correction.** *Ingenium: Undergraduate Research at the Swanson School of Engineering,* 16-20. Link

Miller, A., and Burner, L. (2017). **Aerial Robot Design for Ground Robot Interaction and Navigation without Landmarks.** *IARC Symposium on Indoor Flight Issues.* Link

Presentations

Coupling Control and Vision — Worcester Polytechnic Institute
Perception and Autonomous Robotics Seminar Series (virtual) — October, 2022
Levi Burner

The Advantages of a Control Theoretic Approach to Monocular Computer Vision — College Park, MD
Maryland Robotics Center Student Seminar — October, 2022
Levi Burner — Slides

Fast Active Monocular Distance Estimation from Time-to-Contact — College Park, MD
Maryland Robotics Center Research Symposium — May, 2022
Levi Burner, Nitin J. Sanket, Cornelia Fermüller, Yiannis Aloimonos — Poster

An Explainable and Efficient Representation of the Location of Objects in a Scene — College Park, MD
COMBINE Annual Symposium on Network Biology — May, 2022
Levi Burner, Yiannis Aloimonos — Poster

Interpreting ANN's that Predict Illusory Motion using Network Science — College Park, MD
COMBINE Annual Symposium on Network Biology — May, 2021
Levi Burner, Cornelia Fermüller — Poster

A Novel UAV for Interaction with Moving Targets in an Indoor Environment — Atlanta, Georgia
International Aerial Robotics Competition Symposium Presentation — July 2018
Aaron Miller, Levi Burner, Liam Berti, Evan Becker, and Ritesh Misra (equal contribution) — Slides

6 Degree of Freedom Autonomous UAV — Pittsburgh, PA
Swanson School of Engineering's Design Exposition, Poster Session — April 2018
Levi Burner, Liam Berti, Long Vo, Ritesh Misra (equal contribution) — Poster

Navigation and Control for an Autonomous Multirotor in an Indoor Environment — Pittsburgh, PA
Pennsylvania Automated Vehicle Summit 2018, Student Poster — April 2018
Aaron Miller, Levi Burner, Liam Berti (equal contribution) — Poster

Functional Electrical Stimulation Control and IMU-Based Limb Angle Estimation — Pittsburgh, PA
Science 2017 Undergraduate Research Poster Reception — October 2017
Levi Burner, Dr. Nitin Sharma — Poster

Aerial Robot Design for Ground Robot Interaction and Navigation without Landmarks — Atlanta, Georgia
International Aerial Robotics Competition Symposium Presentation — July 2017
Aaron Miller, Levi Burner (equal contribution) — Slides

Service

Reviewer for: Robotics and Automation Letters, Transactions on Pattern Analysis and Machine Intelligence, Automatica, Signal Processing Letters, ICRA (2022 – 2024), Frontiers in Robotics and AI, The Visual Computer

Student Ambassador for Perception and Robotics Group — **Maryland Robotics Center**
Represent research group during tours and outreach events — *Spring 2023–Present*

Editorial Assistant to the Editor of Rapid Communications — **Automatica**
Assist Professor André Tits in handling editorial duties for the Rapid Publications of Automatica — *Fall 2020–Present*

TA Training and Development Fellow — **University of Maryland**
Lead workshops for all GTA's and mentored incoming GTA's — *Fall 2020–Spring 2021*

Terp's in Space Mentor — **University of Maryland**
Mentor undergraduates to design and propose an experiment for the International Space Station — *Spring 2021*

Technical Director of Undergraduate Robotics Club — **University of Pittsburgh**
Guided growth from 40 to 80 members total, grew funding from 4 to 15 thousand per year — *Spring 2016–Spring 2018*

Teaching

Teaching Assistant — **University of Maryland**
CMSC 477: Robotics Perception and Planning — *Spring 2023*
Was the primary designer of the lab instruction for CMSC477, the final course in UMD's first offering of an Undergraduate Robotics Minor. The course was taught by my advisor Professor Yiannis Aloimonos.
I attended the American Society for Engineering Education (ASEE) 2023 to showcase the course at UMD's tradeshow booth.

Anonymous student feedback:
- "Levi was the best TA i have ever had. He was very knowledgeable and was easy to approach as well as good at giving advice/answers."
- "Levi was always very encouraging of questions and gave great answers to questions."

ENEE 408I: Capstone Design Project: Autonomous Control of Interacting Robots — *Spring 2020 – Spring 2023*
During the summer of 2020, applied for and received $13,000 dollars of funding with Dr. Gilmer Blankenship to redesign course for online presentation during the COVID pandemic. Redesigned the course again in the summer of 2021, with completely custom robots, for the upcoming in-person courses. Dr. Blankenship retired at the end of Spring 2022, and I continued teaching the course with Dr. Shihab Shamma till Spring 2023.

Anonymous student feedback:
- "Levi was one of the best TAs I've had at UMD, he was very knowledgeable on the subject and super helpful. He also helped in a way that helped you learn ...I feel like I got a lot better at troubleshooting issues on my own thanks to his help."
- "Levi Burner is one of the all time greatest TAs ... approachable to help students work through issues while still proactively helping them realize how they can solve their own problems ... one of those rare people who's sociable while at the same time extremely smart and helpful, and I'm thankful we had him for a TA."
- "Levi is an incredible TA. He's knowledgeable, approachable, and clearly cares about every student. Give him a raise."
- "You are likely one of the 2 top TAs I've had at this university. It is rare for me to ask a deep question of a TA and get a thoughtful, deep, and informative response. I strongly appreciate what you have done for the course."
- "I have never had a TA so engaged in the course and so ready to help at the drop of a hat. He was amazingly impressive at helping us troubleshoot problems and learn new topics throughout the class."

ENEE 661: Nonlinear Control Systems — *Spring 2021*
- "TA was very effective at answering questions via Piazza and his efforts helped much during the course."

ENEE 440: Microprocessors — *Fall 2020*
- "Levi was a fantastic TA. Always quick to reply and extremely knowledgeable."
- "Responsive to emails, took time to look through tricky issues, ... allowed for meetings outside of his normal office hours."

ENEE 324: Engineering Probability — *Fall 2019*
- "Levi always made it a pleasure to come to the early discussion time! He was always very helpful and willing to help"
- "Levi is a great TA and knows his stuff. Really enjoyed going to discussion as he was very helpful."

Industry Experience

Naval Research Laboratory   **Washington D.C.**
Student Trainee Electrical Engineer   *July 2021–February 2022*
Developed software infrastructure for research in space robotics using MuJoCo, C++, and Python

Carnegie Robotics LLC   **Pittsburgh, PA**
Software Engineer I   *January 2019–July 2019*
Software Engineering Intern   *June 2018–December 2018*
Designed electronics and software for multi-camera systems operating in extreme environments. Contributions include: Buildroot based Linux system for NVIDIA Jetson, microphone pipeline with wide dynamic range (50-100 dBA), ChibiOS STM32 firmware with USB connectivity, comprehensive release testing framework, solutions for complex Android WebRTC issues.

KLC Electronics   **Lake Havasu City, AZ**
Embedded Software Developer, part-time   *June 2012–January 2019*
Programmed Microchip PIC based embedded systems for utility grade wind turbines ranging in size from 60 to 750 kW

Rockwell Automation   **Mayfield Heights, OH**
Embedded Software Engineering Co-Op   *May 2016–December 2016*
Developed methods for memory bus signal integrity evaluation and run-time tests of low-level CPU functions for a safety certified industrial controller. Co-led a team that developed an interactive checker playing robot for recruiting events.

Undergraduate Research

NSF Center for Space, High-performance, and Resilient Computing   **University of Pittsburgh**
Hardware-in-the-loop Simulation of CubeSat Flight Control   *August 2018–March 2019*
Collaboration with Christopher Manderino advised by Prof. Alan George   [Project Page]

Gallium Nitrate (GaN) FET DC Circuit Breakers for Space   *May 2017–November 2017*
Worked under Dr. Ansel Barchowsky to design prototype through simulation and identify failure modes

Sharma Lab: Neuromuscular Control and Robotics   **University of Pittsburgh**
Wearable Sensing System to Estimate Lower Limb State   *May 2017–August 2017*
Worked under Dr. Nitin Sharma on lower-limb state estimation using six IMUs for correction of foot drop   [Project Page]

Selected Undergraduate Projects

Recreation of the 1972 Magnavox Odyssey
Collaboration with Dr. Zachary Horton   *2018–2019*
Recreated the first video game console (Magnavox Odyssey) using only analog circuitry. Led to a special collaboration with Smithsonian National Museum of American History to attempt operation of 1967 prototype.   [Project Page]

International Aerial Robotics Competition (IARC) Mission 7
Team Co-Founder with Aaron Miller, Electronics and Controls Team Lead   *July 2016–August 2018*
Co-founded team that combined contributions from over 30 students. Designed and demonstrated a 5 kg UAV with 6 cameras capable of autonomous interaction with moving targets using only onboard perception.

In 2017, received 2 out of 6 awards at the American Venue for most points and Best System Design. In 2018, received these awards again, along with Best Technical Paper, for a total of 3 out of 6 awards.

My technical contributions, including robust computer vision and control techniques, are documented on this [Project Page].

Select Documentation: [Technical Postmortem], [Club Project Page], [2018 Technical Paper]

News and Press Releases: [Pittwire], [SSOE Annual Report 2017: Page 15], [Pittsburgh Tribune], [Swanson School of Engineering News 2017], [Unmanned Systems Technology]

UAV with 6 Controllable Degrees of Freedom   **Senior Capstone Project**
Member of 4 person team   *January 2018–May 2018*
Designed an autonomous UAV with a special rotor configuration to increase the controllable degrees of freedom from 4 to 6. Won 3rd place in ECE at Pitt's senior design exposition   [Project Page]

Technical and Soft skills

- **Programming Languages:** *Experienced:* Python, C, Matlab *Capable:* ARM assembly, C++, Go
- **Software:** *Experienced:* MuJoCo, OpenCV, ROS, SciPy, NumPy, ChibiOS *Capable:* JAX , PyTorch, Buildroot, LaTeX
- **CAD:** *Capable:* KiCad, SolidWorks *Beginner:* Altium Designer, Eagle, LTSpice
- **Embedded Platforms:** *Experienced:* NVIDIA Jetson, PIC, STM32
- **Other:** *Capable:* Electronics design, PCB rework, multirotor design, rapid prototyping

References

- Dr. Yiannis Aloimonos *Professor, University of Maryland*
- Dr. Cornelia Fermüller *Research Scientist, University of Maryland*
- Dr. André Tits *Professor, University of Maryland*