

SAMUEL M. BATEMAN

sam@bateman.io

EDUCATION

University of Colorado - Boulder

May 2020

B.S. in Computer Science

B.S. in Applied Mathematics

Overall GPA: 3.669

PUBLICATIONS

S. Bateman, K. Harlow and C. Heckman, [Better Together: Online Probabilistic Clique Change Detection in 3D Landmark-Based Maps](#), *2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*.

- Developed a novel Bayesian feature persistence filter for robustly updating landmark based navigation maps and rejecting poor landmarks during robot operation to enable lifelong, continuous robot deployment and a true semantic, dynamic, probabilistic SLAM algorithm.
- The feature persistence filter leveraged semantic information to reason about the joint likelihood of feature persistence based on their grouped semantic relationship.
- Developed a 3D sensor simulation to compare performance of the Joint Clique Filter against previously developed persistence filters.

T. Teil, **S. Bateman** and H. Schaub, [Autonomous On-Orbit Optical Navigation Techniques for Robust Pose-Estimation](#), *AAS Guidance, Navigation and Control Conference 2020*.

- Developed a novel hybrid learned/classical orbit estimator for the classically challenging on-orbit visual orbit determination task.
- The proposed estimator had > 50% reduced orbit position and velocity RMSE compared to prior art and was trained using synthetic data generated from high fidelity simulations.
- In addition, we developed new data augmentation techniques specific to the unique characteristics of deep learning for spacecraft optical navigation and spacecraft imagery.

T. Teil, **S. Bateman** and H. Schaub, [Closed-Loop Software Architecture for Spacecraft Optical Navigation and Control Development](#), *AAS The Journal of Astronautical Sciences 2020*.

- Developed a realtime spacecraft camera simulator integrated with the high-fidelity Basilisk Astrodynamics Framework, allowing for hardware in the loop simulation of spacecraft algorithms incorporating visual data.
- Opened the door to further exploration of on-orbit navigation and other vision based algorithms.

S. Bateman, K. Harlow and C. Heckman, [An Exploration of Algorithms Enabling Dynamic, Semantic, Probabilistic SLAM](#), *Senior Thesis*, May 2020.

- Developed a robust, real-time multi-object tracking system in C++, leveraging lidar and camera sensor inputs and Mask R-CNN for object detection.
- Said multi-object tracking system was capable of long term, multi-day deployments and would reidentify previously seen objects on a given trajectory.
- Applied this multi-object tracking system to data mine the Oxford Robot Car dataset to estimate feature survival time priors to be consumed by a feature persistence filter.

PROFESSIONAL EXPERIENCE

Localization and Mapping Team - Autonomy - Nuro

Software Engineer

June 2020 - Current

Mountain View, CA

- Lead the development, evaluation, and deployment of novel algorithms and evaluation methodologies enabling superior localization, mapping, calibration, and scene understanding capabilities and reliability.
- Helped develop and build a high reliability, multi city scale, centimeter accurate HD mapping pipeline.
- In particular, focused on methods surrounding: novel sensor noise models, factor graph optimization, GNSS/IMU methods, lidar registration, and deep learning for semantic scene understanding.
- Helped lead the literature review, design, prototyping, and development of a state of the art online semantic mapping system.
- Worked with and mentored by a number of remarkably talented roboticists.

Autonomous Robotics and Perception Group - Computer Science - CU Boulder

May 2019 - June 2020

Undergraduate Researcher

Boulder, CO

- Studied under Professor Christoffer Heckman to develop a novel approach to the dynamic, semantic, probabilistic SLAM problem for localization and mapping of long-term robotics deployments.
- Developed a novel scene change detection system utilizing a Bayes filter to jointly model the survival statistics of keypoints existing on an object.
- Developed an object tracker that utilized Mask R-CNN to track static and dynamic objects in a scene and track the survival statistics of keypoint features observed on those objects.

Autonomous Vehicle Lab - Aerospace Engineering - CU Boulder

Research Assistant

Aug 2018 - May 2020

Boulder, CO

- Developed much of the optical sensors and navigation simulation capabilities of the high-fidelity astrodynamics framework, Basilisk, as Python extensions written in C++.
- Worked closely with a PhD Student to perform novel research in the field of state estimation in astrodynamics using simulated optical sensors.

Massachusetts Institute of Technology - Lincoln Laboratory

Summer Research Intern

May 2019 - Aug 2019

Boston, MA

- Performed self-directed research on unsupervised deep learning for semantic segmentation.
- Worked with an interdisciplinary team in the Humanitarian Aid and Disaster Relief Systems group.

Polycom

Software Engineering Intern

May 2018 - Aug 2018

Westminster, CO

- Developed a customer facing, large scale web product for device deployment management utilizing Java for backend APIs and modern Javascript frameworks for the front end.
- Developed a unique, legacy compatible, system design to improve upon an existing system.
- Worked with two other interns and one full time staff to lead a team of international engineers in building this system.

Office of Information Technology - CU Boulder

Desktop Support Technician

Sept 2017 - May 2018

Boulder, CO

- Troubleshooted a variety of software and hardware IT issues for customers. Had exposure to a wide variety of system types and configurations.

- Held office hours for the Computer Systems course in the Computer Science Department with topics including: Virtual Memory, System Interrupts, Buffer Overflow Attacks, Return-Oriented Programming, Pipelining, Caching, Instruction-Level Parallelism, Assembly Programming, Computer Architecture and more.

SERVICE

ICRA 2021, 2022, 2023, 2024 Reviewer

IROS 2022 Reviewer

Instructor for Nuro ML University Internal Training Program

Organizer of Nuro Mapping Reading Group/Seminar

HONORS

Awarded NSF 2023 CISE (CSGrad4US) Graduate Fellowship (\$159,000 support over 3 years)

CU Boulder Engineering Merit Scholarship, 2019-2020

Dean's List, Spring 2018-Summer 2020

CU Boulder Engineering Discovery Learning Award for Outstanding Undergrad Research, 2020

RELEVANT COURSES

Robotics Courses

Computer Vision, Advanced Robotics,
Autonomous Vehicle Challenge Seminar,
Introduction to Robotics

Applicable CS Courses

Data Structures, Algorithms, Operating Systems,
Software Development and Tools,
Computational Biology,
Programming Languages and Interpreters,
Human-Computer Interaction

Applicable Math Courses

Operations Research, Applied Probability,
Markov Processes, Numerical Analysis,
Discrete Mathematics, Applied Linear Algebra,
Multivariable Calculus, Differential Equations,
PDEs, Analysis, Multivariate Analysis,
Complex Analysis, Mathematics of Cryptosystems,
Chaotic Dynamics