Colin Balfour

colinbalfour@gmail.com | colinbalfour.github.io | github.com/ColinBalfour

Skills

Languages: Python, C/C++, MATLAB, Java/TypeScript, Java
Tools: ROS1/2, Docker, PyTorch, Blender, Jetson/Coral/Arduino, TensorFlow, OpenCV, Ardupilot, Simulink

Education

Worcester Polytechnic Institute – MS in Robotics Engineering (4.0/4.0) May 2027
Worcester Polytechnic Institute – BS in Robotics Engineering, Minor in Mathematics (3.81/4.0) December 2026

Experience

Research Intern - Physical Sciences & Systems, RTX BBN Technologies – Cambridge, MA May 2025 – Present

- Researched novel communication with neuromorphic sensors to support potential multi-million dollar contract
- Performed statistical analysis of post-FEC bitrates under varying environmental conditions to finalize prototype
- Designed monitoring system for high speed data acquisition pipeline reducing 8+ hr/week of maintenance

Student Researcher, PeAR Group (WPI) – Worcester, MA May 2024 – Present

- Researching novel deep RL agents for high speed drone navigation using neuromorphic event cameras
- Researching online adaptation with RL for vision-based uncertainty-aware quadrotor navigation
- Developed autonomous echolocation-based quadrotor navigation in degraded visibility (fog, low light) at 2m/s
- Designed a novel active-vision based hierarchical RL navigation policy for quadrotors using monocular flow
- Deployed ResNet, UNet, and custom vision models on edge devices like Google Coral TPU, Jetson Orin Nano
- Used signal processing techniques to reduce propeller noise by over 50% from ultrasound measurements
- Designed and calibrated data collection rig with sub-mm extrinsics for depth cameras, LiDAR, and various novel sensors with ROS2 at 10GB/min; stitched pointclouds to create a combined depth image with 170-degree FOV

Team Captain & Software Lead, FIRST Robotics Team 3205 – Concord, MA Oct 2021 – May 2024

- Responsible for managing a team of 40+ students and training 10+ students in robotics software
- Created a complete perception pipeline for localization and object detection on an NVIDIA Jetson, fused with a Kalman Filter, using a stereo depth camera, AprilTag detection, and MobileNetv2
- Followed kinodynamic time-optimal trajectories with error under 5cm 1s after stopping and 20cm while moving
- Wrote a PID + FF controller for two jointed arm using IK with dynamic path generation
- Developed and tested a robust autonomous routine to perform many picking-up and shooting tasks; written to be highly adaptable so a brand-new auto routine could be created with just a few lines of code in ∼10 minutes

Publications

- *[Under Review]* K. Srivastava*, **C. Balfour***, D. Singh, N. Sanket | ***ActiveNav: Learning Active Monocular Flight in Forests*** , IEEE Robotics and Automation Letters 2025
- *[Second Review]* M. Velmurugan, P. Brush, **C. Balfour**, R. Pryzbala, N. Sanket | ***Saranga: milliWatt Ultrasound for Navigation in Visually Degraded Environments on Palm-Sized Aerial Robots***, Science Robotics 2025

Projects

Einstein Vision: 3D-Rendered Full Self-Driving Perception Pipeline github.com/ColinBalfour/Einstein-Vision

- FSD perception stack for a self-driving car, using a variety of models with only a single camera
- Pre-trained models were used for object detection, depth estimation, optical flow, and instance segmentation
- Objects are tracked in 3D, along with collision prediction, motion detection, and lane detection

3D Scene Reconstruction github.com/ColinBalfour/SfM-NeRF

- Developed a classical Structure-from-Motion (SfM) pipeline to find camera poses and reconstruct the scene
- Implemented the original Neural Radiance Field (NeRF) paper in pytorch, trained on common NeRF datasets