

Charles Ballentine

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Education

- North Carolina State University
B.Sc. Aerospace Engineering, Magna Cum Laude GPA 3.53/4.0
- Key Electives: Computer Programming, Statistics, Control Theory, Electronics
- Raleigh, NC
August 2016 – May 2020

Research Projects

- VisPOD and AutoLabeler – Automated Data Collection and Keypoint Labeling for Pose Detection Models
 - Enable training of pose detection models on naval assets by collecting time-synchronized real-world video, RTK GPS, and IMU data
 - I improved time synchronization and hardware reliability, as well as general reliability of in-house software stack
 - I performed data collection and improved the storage system, organizing it and translating between formats for different model frameworks
- SICWAVE – Multispectral Image Generation and Labeling for Computer Vision Models
 - Generate and label visual, LWIR, and MWIR imagery of naval assets at sea to enable computer vision model training
 - I greatly optimized image generation stack, leading to 10x performance increase
 - I created a photorealistic photogrammetry model of our Naval ship, greatly improving sim2real transfer and survey accuracy
- VisNAV CVN – Pose Estimation of an Aircraft Carrier Using Fleet Sensors
 - I was lead (sole) researcher on an effort to port much of our work to a CVN and F18 data collection setup
 - I created a keypoint detection dataset based on unsynchronized aircraft sensor, radar, and video data
 - I compared models trained on this to ones trained on synthetic data across multiple sensor modalities
 - I evaluated the pose estimation results from these models against my computed truth data
- CLAMS – Cooperative Lifting using Autonomous Multirotor Systems
 - Use nonlinear trajectory optimizer to move payload using multiple small airframes working together
 - I wrote the ground control station allowing multiple drones to be commanded in unison, as well as improving communication reliability
- Multiplicative Extended Kalman Filtering for Keypoint Based Pose Estimation
 - Kalman filter for sensor fusion of IMU, GPS, and keypoint detections from ML computer vision model
 - I architected and implemented the framework to allow the filter to fly on real hardware, provided truth data for filter tuning, and helped develop the motion model for the relative pose fusion
- VisNAV – GPS Denied Visual Navigation for Shipboard Autonomous Landing
 - I was lead researcher on project to autonomously land on a Naval ship using only a monocular camera and IMU
 - Ground up developed entire flight stack, selected and tuned model framework for real-time operation, tuned dataset sim/scale/real mix, refined keypoint selection for best PnP performance, wrote all ancillary software, and extensively flight-tested airframes running my stack
 - Successfully autonomously tracked and followed underway Naval asset on first attempt

Work Experience

- NAVAIR Air Systems Group
Aerospace Engineer, Flight Controls Branch
- Worked on flight control team for CH-53K, the Navy's first full-authority fly-by-wire helicopter
- Ensured safety of flight during testing of model-following inverse-plant control laws, primarily by studying the Simulink implementation and evaluating test results
- Patuxent River, MD
Sept 2020 – Aug 2022

- NAVAIR Simulation Division
Simulation Engineer, F-35 Lab
 - Operated high-fidelity F-35 flight simulator for test pilot mission rehearsal and non-military customers
 - extended and updated simulation code using modern C++ design patterns
 - wrote control panels in C# integrating software components and computer hardware into a more unified system
- NAVAIR Simulation Division
Software Engineer, WSCE Team
 - Worked as part of Joint Simulation Environment development effort
 - Wrote and characterized high-fidelity 6DOF missile models for simulation
 - Personally developed from scratch plugin system to allow in-house and industry-provided models in existing simulation software (NGTS)
 - Developed SQLite database solution for storing millions of weapon launches and their results for design analysis and sim validation
- NAVAIR Air Systems Group
Associate Scientist, MagicLab
 - Built up lab infrastructure, namely a LAN to host Gitlab and other services on air gapped network while meeting NDAA requirements
 - Mentored visiting researchers in embedded software development
 - Began research career (see above)

Patuxent River, MD
Aug 2022 – Apr 2023

Patuxent River, MD
Apr 2023 – Mar 2024

Patuxent River, MD
Mar 2024 –

Publications

please note that the nature of my employment prevents traditional publication

- Carrier-Ready Autonomy: Demonstration of A Real-Time Visual Navigation Framework for UAS on CVNs
Naval Applications of Machine Learning 2025 [conference presentation]

San Diego, CA
February 2025

Particular Skills

Software Engineering	C++ (near-expert), Python (moderate-to-high skill), JavaScript (novice), Qt, Bash, Docker, ROS 2, TCP/IP, Networking, systemd, Linux
Computer Vision	dataset generation, OpenCV, RANSAC, YOLOvX, OpenPifPaf, Blender, photogrammetry
UAS Technologies	PX4, Ardupilot, MAVLink, Micro XRCE-DDS
State Measurement	Motion Capture, RTK GPS, Kalman Filtering, Radar, Post-Process Time Synchronization, Frame Transformations, Pose Detection