Rylan Noah Malarchick

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Education

Embry Riddle Daytona Beach, FL
BS/MS Engineering Physics (Accelerated), Spacecraft Instrumentation Track, Comp. Math Minor ***Expected May 2027***

Work Experience

NASA Goddard Space Flight Center May 2025 – Aug 2025
OSTEM Intern – Atmospheric Remote Sensing *Greenbelt, MD*

- Developed ML framework for cloud base height retrieval from NASA ER-2 airborne observations, comparing feature-based (GBDT) vs. image-based (CNN) approaches on 933 labeled samples
- Achieved $R^2 = 0.744$ with gradient boosting using atmospheric features (ERA5 reanalysis), outperforming CNNs ($R^2 = 0.320$) by 130%
- Engineered preprocessing pipeline for HDF5 data with temporal interpolation and radiometric correction
- Analyzed domain shift via leave-one-flight-out cross-validation, identified generalization failure ($R^2 = -1.007$), proposed domain-adversarial solutions
- First author on preprint: *"Atmospheric Features Outperform Images for Cloud Base Height Retrieval"* (pending journal submission)

Project Experience

High-Performance Variational Quantum Eigensolver | *PennyLane, JAX, OpenMPI* Oct 2025 – Dec 2025

- Implemented hybrid quantum-classical VQE in PennyLane/JAX to compute H_2 ground state energy across 100 bond lengths, achieving near-exact accuracy (-1.137 Ha at equilibrium)
- Achieved **117× speedup** via 4-phase optimization on ERAU Vega HPC (4× H100 GPUs, 192 AMD EPYC cores): JIT compilation, GPU acceleration, multi-GPU scaling, MPI parallelization
- Reduced H_2 potential energy surface computation from 593.95s to 5.04s (practical for interactive exploration)
- Technical report: *"Parallelizing the Variational Quantum Eigensolver"* (in preparation for future paper submission)

QubitPulseOpt – Quantum Optimal Control Simulation | *QuTiP, Python* Oct 2025 – Present

- Developed Python framework using QuTiP to optimize microwave control pulses for high-fidelity single-qubit gates, achieving 99.14% X-gate fidelity in 20ns simulations (77% error reduction vs. Gaussian baseline)
- Implemented GRAPE with Lindblad master equation for realistic noise modeling (T_1/T_2 decoherence)
- Developed hardware-representative workflow via API connectivity to IQM Garnet 20-qubit processor for calibration retrieval
- Engineered library to NASA JPL Power-of-10 standards, CI/CD pipeline with 864 unit tests, 74% code coverage (85% on critical modules)
- Preprint: *"GRAPE Pulse Optimization for Quantum Gates with Hardware-Representative Noise"* (on arXiv)

AIRHOUND – UAV Pursuit System | *YOLOv8, ROS2, NVIDIA Jetson* Sept 2024 – Present

- Led and co-authored SPARK grant proposal to secure project funding
- Training and optimizing CV models (YOLOv8, RF-DETR) for real-time UAV tracking on NVIDIA Jetson
- Submitted abstract to SPIE Defense & Security 2026, manuscript due April 2026

Technical Skills

Programming Languages: Python, C/C++, MATLAB, Bash/Shell
Quantum Computing: PennyLane, QuTiP, Qiskit, JAX, Catalyst, GRAPE optimization, quantum simulation
High-Performance Computing: OpenMPI (mpi4py), CUDA, GPU acceleration (NVIDIA H100), JIT compilation
Machine Learning: PyTorch, TensorFlow, scikit-learn (XGBoost, LightGBM), NumPy, Pandas
Robotics & Embedded: ROS2, PX4, NVIDIA Jetson, CUDA
Hardware: FPGAs (Verilog, Vivado), Arduino, Pixhawk flight controllers
Developer Tools: Git/GitHub, Docker, Linux/Unix, CI/CD (GitHub Actions), pytest (automated testing)
Data Formats: HDF5, NetCDF, ERA5 reanalysis data

Involvement & Awards

Athletics: NCAA Division II Men's Cross Country and Track (Aug 2023 – Present)
Awards: USTFCCCA Academic All-American (2024, 2025), ERAU Dean's List, ERAU Athletic Scholarship, Campus Goldwater Nominee