

Rylan Noah Malarchick

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EDUCATION

Embry-Riddle Aeronautical University

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 1,426 NASA ER-2 airborne observations across 5 research flights (3 used for final analysis), engineering 38 atmospheric features (10 ERA5 base + 28 physics-derived)
- Achieved $R^2 = 0.744$ with $MAE = 117.4m$ using rigorous per-flight cross-validation; discovered catastrophic domain shift ($R^2 = -15.4$) in cross-flight validation, developed few-shot adaptation recovering $R^2 = 0.57-0.85$
- First author on preprint: “Atmospheric Features Outperform Images for Cloud Base Height Retrieval”

PROJECT EXPERIENCE

QubitPulseOpt – Quantum Optimal Control | QuTiP, Python, GRAPE

Oct 2025 – Present

- Developed pulse optimization framework achieving 99.14% X-gate fidelity in 20ns ($77\times$ error reduction vs. fixed-amplitude Gaussian baseline) using GRAPE with Lindblad master equation for T_1/T_2 noise modeling
- Hardware-aware workflow via IQM Garnet 20-qubit processor API for calibration retrieval
- Strict engineering standards (RAII, zero-warning builds, CI/CD): 864 unit tests, 74% coverage
- Preprint: [arXiv:2511.12799](https://arxiv.org/abs/2511.12799); GitHub: github.com/rylanmalarchick/QubitPulseOpt

High-Performance VQE | PennyLane, JAX, OpenMPI

Oct 2025 – Jan 2026

- Achieved **$117\times$ speedup** on H_2 ground state computation via JIT, GPU, multi-GPU, and MPI optimization on ERAU Vega HPC ($4\times$ H100 GPUs, 192 AMD EPYC cores)
- Preprint: [arXiv:2601.09951](https://arxiv.org/abs/2601.09951) (with A. Steed): “Parallelizing the Variational Quantum Eigensolver: From JIT Compilation to Multi-GPU Scaling”

Quantum Circuit Optimizer | C++17, CMake – Complete

Dec 2025

- Production C++ quantum compiler: OpenQASM 3.0 parser, DAG IR, 4 optimization passes, SABRE routing (linear/grid/heavy-hex); 340 unit tests; designed for cross-layer fidelity analysis

CUDA Quantum Simulator | CUDA, C++17 – Core Complete

Dec 2025

- GPU-accelerated state vector simulator with optimized gate kernels; RAI memory via `CudaMemory<T>`, Lindblad noise models, 9 test suites; up to 29 qubits on single GPU

LLVM Loop Unroll Analyzer | LLVM 18, C++, Scalar Evolution

Dec 2025

- Custom LLVM pass for loop analysis and unroll optimization using Scalar Evolution; foundation for quantum compiler infrastructure work

AIRHOUND – UAV Pursuit System | YOLOv8, ROS2, NVIDIA Jetson

Sept 2024 – Present

- PI and perception lead on team of 7 developing autonomous UAV pursuit system; accepted for presentation at SPIE Defense & Commercial Sensing 2026 (April 28, 2026)

TECHNICAL SKILLS

Programming Languages: Python, C/C++, MATLAB, Bash/Shell

Compilers: LLVM (custom passes, Scalar Evolution), OpenQASM 3.0, DAG-based IR, circuit optimization

Quantum Computing: PennyLane, QuTiP, Qiskit, JAX, GRAPE optimization, quantum simulation

High-Performance Computing: CUDA, OpenMPI (mpi4py), GPU acceleration (NVIDIA H100), JIT compilation

Machine Learning: PyTorch, TensorFlow, scikit-learn (XGBoost, LightGBM), NumPy, Pandas

Developer Tools: Git/GitHub, Docker, Linux/Unix, CI/CD (GitHub Actions), pytest, CMake

INVOLVEMENT & AWARDS

Athletics: NCAA Division II Cross Country and Track – 5k/10k (Aug 2023 – Present); 136th at 2025 NCAA D2 XC Nationals

Awards: Goldwater Scholarship Campus Finalist, USTFCCCA Academic All-American (2024, 2025), ERAU Dean’s List