Logan Luna

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RESEARCH INTERESTS

AI for Mathematical Reasoning (AI4Math). Central question: how can semantically informative training signals be quantified and incorporated into the training and generation of mathematical reasoning models? Symbolic feedback rewards output that compiles or type-checks, which does not certify that it expresses the intended mathematics. Directions: (1) extending reinforcement learning from symbolic feedback with semantic alignment as the training objective, measured by pass@k at large k; (2) dense rewards from distance in a learned proof-semantic space, grounded in kernel-checked entailment; (3) diffusion language models as a generative substrate for theorem proving and auto-formalization.

EDUCATION

Georgia Institute of Technology — Atlanta, GA
Master of Science: Computer Science — August 2026 – Expected December 2027
Specialization: Artificial Intelligence — Track: Thesis

Embry-Riddle Aeronautical University — Daytona Beach, FL
magna cum laude — Honors Program — August 2022 – May 2026
Bachelor of Science: Computer Science/Minor: Applied Mathematics — Cumulative GPA: 3.85/4.00

RESEARCH & PROFESSIONAL EXPERIENCE

Reasoning and Learning Group — Georgia Institute of Technology
Researcher (AI4Math/Auto-formalization) — 2025 – Present
Group Lead: Dr. Vijay Ganesh

- Contribute to *AIProver*, an agentic system that post-trains an open-weight LLM on graded verifier rewards to auto-formalize research mathematics; lifts pass@4 semantic correctness from 15.7% to 36.7%, outperforming GPT-5.6-Sol, Codex, and all other open-weight systems, and from 41.9% to 79.8% as a Claude Code skill **[C4]**.
- *RL pipeline and reward:* extended RLSF (Jha et al., 2025) to multi-turn auto-formalization with GRPO; designed a reward ladder (type correctness, completeness, semantic correctness, length fidelity) that gives graded signal in all-failing rollout groups; extended BEq+ (Poiroux et al., 2025) to score one-directional implication separately **[C4]**.
- *Distillation pipeline:* architected and ran the end-to-end pipeline (teacher generation, Lean verification, error-guided repair, semantic filtering) over 57.9k instances, producing 16,570 Mathlib (12,500 BEq+-equivalent) and 6,799 Mizar examples **[C4]**.
- *Semantic Alignment Model:* trained a joint cross-entropy and contrastive (InfoNCE) objective with LoRA on a 119B MoE model; raised matched NL–Lean cosine from 0.11 to 0.75 and held-out R@1 from 0.01 to 1.00 **[C4]**.
- Developing two directions: reinforcement learning from semantic equivalence feedback, and diffusion language models for AI4Math.

Agile Research Group — Embry-Riddle Aeronautical University
Researcher (Satellite Trajectory Optimization) — 2024 – 2026
Group Lead: Dr. Omar Ochoa

- Developed an RL-based framework (PPO) for fuel-aware satellite collision avoidance in an open-source astrodynamics simulator (two-body dynamics with Sun/Moon third-body perturbations, fuel-dependent thrust, real and simulated debris).
- Studied reward shaping and curriculum learning to balance collision avoidance, fuel conservation, and orbital stability; reached 97.5% avoidance success over 1,000 deterministic GEO episodes against four baselines **[J1]**.
- Built a fully deterministic evaluation pipeline with shared seeds, per-episode logs, and telemetry exports.
- Generalized the group's sensor analysis practice into *SensorWF*, a FAIR workflow framework validated across spacecraft telemetry, ECG, and climate data **[C3]**.

Naval Surface Warfare Center Dahlgren Division (NSWCDD) — Dahlgren, VA
Scientist Intern, Department of Defense (Beam and Optic Control for High Energy Weapons) — 2024 – Present
Active Security Clearance Level: Secret

- *Motion cross-attention detection (2026):* re-architected YOLO into a video detector with a motion cross-attention stream fusing frame-difference cues into the backbone at three scales; substantially improved small, low-visibility object detection in clutter.
- *Temporal features (2025):* designed a lightweight temporal feature approach to improve stability when targets appear infrequently, under deployment constraints that limited heavier temporal models.
- Built a real-time tracking pipeline (YOLO, ORB keypoint matching, homography-based optical flow, re-identification, Kalman filtering), integrating additional sensing inputs to improve detection precision and track continuity.
- Authored an internal technical report for program stakeholders (not publicly releasable).

PUBLICATIONS

Journal Articles

[J1] **Logan Luna**, Juan Ortiz Couder, Raul Alejandro Vargas-Acosta. *IEEE Access*, 2026
Satellite Trajectory Optimization via Proximal Policy Optimization for Space Debris Avoidance. DOI
97.5% collision-avoidance success over 1,000 deterministic GEO episodes, 76.8 and 70.0 percentage points above the rule-based and impulsive Δv baselines.

Peer-Reviewed Conference Papers

[C1] **Logan Luna**, Matthew P. Berkowitz, Laxima Niure Kandel, Sirio Jansen-Sánchez. IEEE SoutheastCon, 2025
Dueling Deep Q-Learning for Intrusion Detection. DOI
Best Paper Award (IEEE–Eta Kappa Nu)
99.68% multi-class accuracy on 2.18M CIC-IDS2018 flows, against 88% for prior DQN-based detection (Alavizadeh et al.) and 98.4–99% for tree-ensemble and random-forest IDSs; SHAP attribution of the learned policy.

[C2] **Logan Luna**, Sirio Jansen-Sánchez, Ilteris Demirkiran, Leo Ghelarducci. IEEE SoutheastCon, 2025
Signal-Centric Remote Sensing via Alternative Preprocessing and Acoustic Processing for ML-Driven Applications.
Presented in person, Concord, NC, USA. Developed within AMRA **[P3]**. DOI
91.2% reduction in total sonar processing time (13.1% in filtering alone) against image-based CV processing, while preserving target structure the image pipeline removed.

[C3] **Logan Luna**, Joseph Rigo, Kellan Shew, Raul Alejandro Vargas-Acosta. IEEE eScience, 2026
SensorWF: A FAIR Generalizable Workflow Framework for Scientific Time-Series Analysis. Code
Presented, Naples, Italy. Externally funded research (CARS / SATLL); Project Lead.
one analytical core carried across spacecraft telemetry, ECG, and climate data with 167–502-line domain adapters and no core changes; bit-identical outputs under fixed seeds; best-detector AUC-ROC 0.772 (18 injected fault types across 122 CubeSat channels, against 0.610 for a z-score baseline), 0.918 (ECG), 0.835 (climate).

Under Review

[C4] Prithwish Jana, Viet Bach Hoang, **Logan Luna**, Viresh Pati, Akash Singirikonda, Cy Xie, Lisa Carbone, Wuyang Chen, Walter Moreira, Joe Stubbs, Sriram Vishwanath, Vijay Ganesh. ICLR 2027
AIProver: Agentic Auto-Formalization of Mathematical Research via Certificate-Driven Evolving Harness.
Contribution: RL pipeline and reward, BEq+ extension, distillation pipeline and dataset, Semantic Alignment Model.
Results: 15.7% to 36.7% standalone (above GPT-5.6-Sol and Codex); 41.9% to 79.8% as a Claude Code skill.

Research Posters & Presentations

[P1] **Logan Luna**, Sirio Jansen-Sánchez, Vincent Reggi, Kolton Galie, Nicolas Andricos. Senior Design, Embry-Riddle, 2026
AERO-Sim2Real: Reinforcement Learning for Sim-to-Real Drone Deployment.
PPO policies trained in NVIDIA Isaac Lab and flown autonomously on Crazyflie 2.1 hardware; hover transferred at 1.3/2.1/0.7 cm real-vs-sim RMSE, while a figure-eight task drove lateral error to 40.7 cm against 8.9 cm (Y) and 9.1 cm (Z), isolating aggressive horizontal maneuvering as the dominant transfer gap.

[P2] Madeline Gorman, Katherine Hoffsetz, **Logan Luna**, Stephanie Ramsey. Discovery Day, Embry-Riddle, 2025
Learning Causal Structures from Aviation Accident Narratives. *(Authors listed alphabetically)*
rule-based NLP, fine-tuned DistilBERT, and few-shot Mistral-7B compared for causal-triple extraction from 6,059 NTSB narratives; the LLM more than doubled narrative coverage (94.5% vs. 44.9%) without improving category alignment (48.7% vs. 50.5%), separating coverage from correctness as failure modes.

[P3] **Logan Luna** (Autonomous Maritime Robotics Association). Student Research Symposium, Embry-Riddle, 2024
Techniques for Filtering Noise in Sonar Data while Managing Time Complexity of Machine Learning Algorithms.
sonar noise-filtering and detection study weighing accuracy against time complexity for onboard AUV use; progressed into **[C2]**.

[P4] **Logan Luna**. National Conference on Undergraduate Research 2023; Student Research Symposium, Embry-Riddle, 2023
Enhancing Aircraft Recognition and Localization through Object Detection and Feature Point Tracking with Kalman Filtering.
1st Place, Student Research Symposium
study combining YOLO detection, ORB feature tracking, and Kalman prediction; ORB matching sustained track identity through partial occlusion and low-confidence detections where YOLO alone dropped the target.

TEACHING, MENTORING & SERVICE

Foundations of AI Seminar Series — Georgia Institute of Technology 2026 – Present
Seminar Coordinator; Faculty Organizers: Dr. Vijay Ganesh, Dr. Yingyan (Celine) Lin

- Run the series end to end: speaker correspondence, scheduling, venue booking, catering, website updates, and talk announcements.
- Host visiting speakers on campus and arrange their meetings with graduate students in the research group.
- Speakers: Young Jin Kim (Microsoft Research), Daniel Kroening (Amazon); upcoming: Alexandre Rademaker (EMAp/FGV).

Workshops — Embry-Riddle Aeronautical University 2023 – 2026
Hosted in collaboration with AMRA; open to the Department of Electrical Engineering and Computer Science

- *Competitive Fellowship Applications* (2024–2025, ∼20 attendees): application strategy, research statements, and technical interviews; 6 attendees went on to receive DoW SMART Scholarships.
- *Introduction to Programming* (∼30 attendees): project-based Python, from fundamentals to OpenCV color masking on live camera feeds and sonar-data analysis in Pandas.
- *Introduction to Machine Learning* (∼10 attendees): end-to-end training of a YOLO object detection model as a first project.

Peer Mentor — Office of Undergraduate Research 2023 – 2024
Appointed mentor for integrating incoming students into the research community

- Mentored two aerospace engineering students (J. Feeley, R. Nagarajan) on project and team leadership, grant preparation, conflict resolution, and career preparation, and connected them with faculty in their own subfield.
- Outcomes: a research position in an Embry-Riddle aerospace engineering laboratory, and an engineering internship at Boeing.

Undergraduate Research Mentoring — Agile Research Group 2025 – 2026

- Mentored two undergraduate researchers (J. Rigo, K. Shew) through a full research cycle: framing the research question, collecting and validating data, designing and running experiments, and drafting and revising the manuscript.
- Both progressed from first exposure to research to co-authorship on a peer-reviewed conference paper **[C3]**.

RoboSub Team — Autonomous Maritime Robotics Association (AMRA) 2022 – 2026
Software Department Head

- Lead AUV autonomy software (computer vision, sonar processing, ML-based decision-making); 16th of 52 schools internationally.
- Built training/onboarding processes and a supportive team culture to improve retention and development speed.
- Developed the team's sonar processing and perception work into a peer-reviewed publication **[C2]**.

GRANTS & FUNDING

Total funding secured: $27,960

- **Center for Aerospace Resilient Systems (CARS)**. Research Grant ($24,000). 2026
  AI for Data Anomaly Detection in a Satellite Learning Laboratory (SATLL) (Project Lead) **[C3]**.
- **Embry-Riddle Aeronautical University — Office of Undergraduate Research**. Spark Grant ($600). 2025
  Conference travel support for IEEE SoutheastCon (Project Lead) **[C1, C2]**.
- **Embry-Riddle Aeronautical University — SIG Research Project Grant**. Research Grant ($3,360). 2024–2025
  Signal-Centric Remote Sensing via Alternative Preprocessing and Acoustic Processing for ML-Driven Applications **[C2]**.

AWARDS

- Embry-Riddle's Outstanding Undergraduate in Computer Science 2025 & 2026
- IEEE–Eta Kappa Nu Best Paper Award **[C1]** 2025
- DoW SMART Scholarship 2023 – Present
- 1st Place, Embry-Riddle Student Research Symposium **[P4]** 2023

SKILLS

Programming & Tools	Python, C/C++, Java; Git, Docker, Linux, NVIDIA Isaac Lab, Lean
ML/CV	PyTorch, TensorFlow, OpenAI Gym, SHAP, OpenCV, YOLO
Mathematics	Linear Algebra, Calculus I–III, Differential Equations, Probability & Statistics, Discrete Mathematics, Optimization

REFERENCES

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