Mark Ciora, M.S.

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Summary

Perception and high performance computing specialist with a Master's in Computer Engineering and 3+ years delivering advanced, GPU-accelerated solutions at the intersection of tracking, simulation, and machine learning. Proven record of architecting end-to-end data processing pipelines for national security and space systems at MITRE and the NSF SHREC Center. Skilled in bridging algorithm design with systems engineering to enable real-time, mission-critical performance under operational constraints.

Skills

Python	PyTorch	Numpy	OpenCV	MATLAB
C++	CUDA	OpenMP	Baremetal C	Assembly (ARM, RISC-V)
HPC	Parallel Programming	Kernel Programming	Linux	Networking
Tracking	Bayesian Filtering	Sensor Fusion	Estimation Theory	Model Predictive Control
Machine Learning	Reinforcement Learning	Computer Vision	DSP	Numerical Optimization

Work Experience

MITRE – Sensor Processing Engineer – *Bedford, MA* May 2024 - Present

- Deployed a transformer-based model within a missile tracking pipeline, boosting false track point detection accuracy from 81% to 93%, significantly improving tracking reliability
- Built a classification pipeline for synthetic aperture RADAR (SAR) data using CNNs, Radon Transforms, morphological filters, and clustering, achieving 92% accuracy in region-of-interest detection
- Designed and evaluated sensor tasking algorithms for multi-sensor, multi-target assignment using Q-Learning, PPO, and MCTS, validating performance in high-fidelity orbital simulations with physics-based dynamics modeling satellites and ballistic missiles

NSF SHREC Center – Graduate Researcher – *University of Pittsburgh, Dr. Alan George* August 2023 - April 2025

- Authored and defended M.S. thesis on sensor tasking for space situational awareness; work was published and presented at IEEE-SCC 2025, titled "Satellite Sensor Tasking with Cyclic Slewing for Space Situational Awareness and Tracking" [2]
- Developed the Cyclic Slewing Sensor Tasking Algorithm (CSSTA) — a novel approach leveraging linear system theory, estimation theory, and convex optimization to improve tasking efficiency in missile tracking and orbital monitoring
- Led technical research meetings with Dr. Zhi-Hong Mao and two graduate researchers, advancing novel reinforcement learning approaches for sensor tasking and conducting comparative literature analysis
- Designed and simulated missile guidance models for intercepting maneuverable hypersonic threats using reinforcement learning, demonstrating superior robustness over proportional navigation under diverse conditions

NASA – Software Engineer – *Katherine Johnson IV&V Facility, Fairmont, WV* May 2022 - August 2023

- Co-developed testing environments, mission simulations, and analysis tools for the NASA Artemis mission as part of the award-winning JSTAR engineering team
- Engineered a Linux kernel module to virtualize networking operations across machines in integrated Artemis mission testing procedures
- Built Unity-based simulation visualization tools, significantly enhancing user experience based on direct customer feedback
- Automated sqlite3 database workflows in a PyQT analysis tool, streamlining data operations through iterative user collaboration
- Refactored and modernized a QEMU model for the RAD750 processor using updated APIs; validated with flight software to achieve major usability gains

Teaching Assistant – *University of Pittsburgh* January 2020 – May 2025

- *Senior Design*: Provided hands-on mentorship to 83 students throughout the entire design and prototyping lifecycle, guiding multi-disciplinary teams in applying advanced machine learning techniques and robotics principles to real-world engineering challenges
- *Data Structures and Algorithms*: Guided 89 students to mastery of essential data structures like stacks, heaps, graphs, binary search trees, and hash maps, empowering them to apply these concepts effectively algorithmic problem-solving projects
- *Problem Solving in C++*: Taught 41 students foundational programming concepts in C++, covering programming logic, the standard library, and object-oriented design principles
- *Physics II*: Assisted over 100 students in understanding electromagnetics fundamentals, focusing on Gauss's Law, Biot–Savart Law, Maxwell's Equations, and passive circuit analysis

Research Experience

NSF SHREC Center Undergraduate Research – *University of Pittsburgh, Dr. Alan George* January 2022 - April 2023

- Accelerated hyperdimensional computing and NeuralHD classifiers on GPUs using Intel oneAPI, contributing to peer-reviewed work published at IEEE HPEC, "Multiarchitecture Hardware Acceleration of Hyperdimensional Computing" [1]
- Analyzed the impact of various time decay kernels on classification accuracy in the Hierarchy of Event-Based Time Surfaces (HOTS) algorithm for event-driven pattern recognition

SURI Research Internship – *University of Pittsburgh, Dr. Zhi-Hong Mao* May 2021 - August 2021

- Developed low-cost, real-time sleep stage classification methods using EEG signals and MATLAB, targeting portable embedded deployment
- Designed and implemented signal processing and machine learning pipelines using bandpass filtering, feature extraction, and SVM/Bayesian classifiers to distinguish shallow and deep sleep states from EEG data
- Published research in Ingenium 2022, University of Pittsburgh's undergraduate journal: *Ingenium 2022*, "Classification of Shallow and Deep Sleep Using Electroencephalogram Signals in Real Time"

Projects

CSSTADLSurrogate – *CSSTA Extension with DL* – github.com/MarkCiora/CSSTA_DLSurrogate February 2025 - April 2025

- Developed a surrogate optimization framework combining deep learning and partial differential equations to infer gradients for optimizing sensor assignments, extending the Cyclic Slewing Sensor Tasking Algorithm
- Developed and mathematically derived a novel reparameterization scheme that dramatically reduced the complexity of the deep learning model, enabling more efficient optimization without sacrificing the fidelity of the underlying optimization manifold
- Identified performance bottlenecks in simulation runtime and engineered a custom CUDA-accelerated environment, achieving a 1000x speedup to rapidly generate high-fidelity datasets modeling error propagation in Extended Kalman Filter estimations

ParallelBoid – *CUDA and OpenMP Parallelized Simulation* – github.com/MarkCiora/ParallelBoid January 2024 - May 2024

- Co-developed ParallelBoid, an accelerated simulation inspired by the classic Boids flocking algorithm, generating stunning, lifelike bird flock visuals through emergent collective behavior
- Harnessed the power of CUDA and OpenMP to massively parallelize complex physics and steering computations, achieving an astonishing 1905x speedup and enabling real-time scalability to thousands of agents
- Designed and integrated an interactive Unity-based visualization tool to complement the ParallelBoid simulation, enabling intuitive real-time exploration and analysis of flocking dynamics at scale

TREADS – *VR Controlled Rover* – github.com/ewang360/Senior-Design-TREADS January 2023 - May 2023

- Collaborated with a team of five to design and prototype TREADS, a sub-$200 rover controlled via a Meta Quest 2 for search-and-rescue in collapsed buildings
- Implemented a low-latency interface translating Quest 2 head orientation data to a gimbal system, enabling intuitive remote camera control with under 20 ms latency
- Developed a custom WiFi video streaming protocol transmitting serialized JPEG frames, delivering a reliable rover camera feed with latency below 25 ms on a constrained budget
- Integrated live video streaming into a Unity-based VR environment featuring a custom scene, providing immersive situational awareness for remote operators

Education

University of Pittsburgh

M.S. in Electrical and Computer Engineering April 2025, GPA: 3.969

M.S. Thesis: "Sensor Tasking with Cyclic Slewing for Space Situational Awareness and Tracking"

B.S. in Computer Engineering (Autonomous Systems conc.) (Outstanding Student Honorable Mention) April 2023, GPA: 3.904

Publications

[1] Ian Peitzsch, Mark Ciora, and Alan D. George. "Multiarchitecture Hardware Acceleration of Hyperdimensional Computing". In: *2023 IEEE High Performance Extreme Computing Conference (HPEC)*. 2023, pp. 1–7. DOI: 10.1109/HPEC58863.2023.10363602.

[2] Mark Ciora and Alan D. George. "Satellite Sensor Tasking with Cyclic Slewing for Space Situational Awareness and Tracking". In: *IEEE Space Computing Conference (SCC)*. (Accepted). 2025.