

Mark Moussa

mark.moussa1234@gmail.com | (813) 731-0742 | <https://markmoussa.me>

WORK EXPERIENCE

NASA Goddard Space Flight Center

July 2019 – Present

AI/ML Principal Investigator & Research Engineer

Greenbelt, MD

- **Architected and fully developed end-to-end a multimodal Earth-observation AI/ML model** for predicting forest canopy height change. Fuses 426-band hyperspectral cubes, LiDAR CHM/DTM/DSM, vegetation indices, climate time series, and soil parameters; delivered **over 30% lower MAE and over 10% better accuracy** for both 1m and 10m resolution vs. published baselines.
- **Built end-to-end a real-time 2-stage wildfire detection and analysis AI/ML model pipeline** (MobileNet v3 classification → UNet segmentation) that runs **30 ms/frame** on NVIDIA Jetson; quantized model size **over 80% and inference latency by 4x**, with no loss in accuracy, enabling on-board wildfire detection + analysis for airborne and spaceborne use cases. Integrated as part of next-generation wildfire detection sensor instrument.
- **Architected and built AI/ML model for quantitative biosignature flux for intelligent detection of life on exoplanets.** Developed custom Bayesian CNN-based model architecture, built exoplanet atmospheric parameters and spectra dataset from scratch. **Achieved state-of-the-art** accuracy and decreased time to biosignature flux retrieval from months to milliseconds. Model will be utilized to intelligently inform project scientists on exoplanet candidates for \$11 billion Habitable Worlds Observatory (HWO). (Principal Investigator & AI/ML Lead Research Engineer).
- **Pioneered a reinforcement-learning based multi-agent autonomous high-level decision maker** that coordinated methane-plume localization during an Alaska field campaign and informed a next-generation SmallSat constellation concept. Increased mission efficiency by **over 80%** (AI/ML Lead).
- **Lead working group team to develop \$11 billion flagship NASA mission Habitable Worlds Observatory (HWO) AI/ML requirements, design, white papers, to serve the new mission from the ground up.** Developed use cases and proof of concepts for finding habitable worlds, exoplanet characterization, biosignature detection, autonomous mission operations (e.g., data prioritization, anomaly detection, autonomous decision making).
- **Secured over \$5 million in competitive funding** as PI/Co-I for research & development.
- **Developed comprehensive Mixed-Reality Engineering Toolkit** using Unity 3D for AR/VR development of NASA mission hardware, speeding up mission design iterative cycle by **over 60%** (new flagship Roman Space Telescope heavily utilized this for mission design)
- **Built full-stack model-running web service** for the Community Coordinated Modeling Center (CCMC). Over 20,000 users, 27,000 simulation runs, 8,000 interactive visualizations, across 170 countries per month.

Mosaic Voice

Oct. 2023 – Present

Founder/CEO

Remote

- Launched custom multi-modal LLM-powered Augmentative Alternative Communication (AAC) platform that turns symbol taps into fluent first-person sentences. Serving **several thousands of users**.
- Fine-tuned Gemma, Llama, Mistral, Qwen, etc., models with QLoRA, using Supervised Fine Tuning and Reinforcement Learning on a bespoke AAC corpus, beating leading models on function-specific benchmarks.
- Invented novel dynamic multi-LoRA adapter-swapping so each user carries a personal LoRA that updates in real-time, enabling individualized language prediction per user without full model retrain.
- Engineered a hybrid inference stack (serving using vLLM on serverless and AWS SageMaker, and on-device) that serves **ultra-low latency** cloud responses
- Developed on-device inference using ExecuTorch models for mobile devices, saving **over 20% in cloud costs**.
- Architected and built full-stack production code (React Native/Expo, FastAPI backend, NoSQL DB, AWS S3/SageMaker/EC2) across iOS & Android.

EDUCATION

University of South Florida

December, 2018

B.S., Computer Science & B.S. Biomedical Sciences

Tampa, FL

- **GPA: 3.84/4.0** Honors; Minor in Biomedical Physics

SELECTED PUBLICATIONS (full list available on [Google Scholar](#))

Life, Machine Learning, and the Search for Habitability: Predicting Biosignature Fluxes for the Habitable Worlds Observatory

Mark Moussa, Amber Young, Brianna Isola, Vasuda Trehan, Michael Himes, Nick Wogan, Giada Arney

Accepted, to appear

AAAI, 2026

PyroFocus: A Deep Learning Approach to Real-Time Wildfire Detection in Multispectral Remote Sensing Imagery

Mark Moussa, Andre Williams, Seth Roffe, Douglas C Morton

Accepted, to appear

ICCV SEA Workshop (proceedings track), 2025

A Novel Framework for Multi-Path Data Fusion in Earth Observation and New Observing Strategies: Applications to Predicting Forest Canopy Height

Mark Moussa, James MacKinnon, David Harding, Matthew Brandt

10.5281/zenodo.13885555

SPAICE, 2024

Multimodal Earth Observation Workflow for Machine Learning: A Case Study in Canopy Height Change Prediction

Mark Moussa, James MacKinnon, David Harding, Matthew Brandt

<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1682021>

AGU, 2024

Using Artificial Intelligence and Machine Learning to Enhance Mission Design and Operations of the Habitable Worlds Observatory (HWO)

Victoria Da Poian, **Mark M. Moussa** (Presenting author), Umaa Rebbapragada, John Wu, Emilio Salazar-Donate, Ehsan Gharib-Nezhad, Vicki Toy-Edens, Hamsa Venkataram, Mark Giuliano, Steve Chien, Aquib Moin, Gautier Bardi de Fourtou, Connor Basich, Eric Lyness, Bruce Dean, Megan Ansdell

<https://agu.confex.com/agu/agu24/meetingapp.cgi/Paper/1706755>

AGU, 2024

An Autonomous Agent Framework for Constellation Missions: Use Case for Predicting Atmospheric CO₂

Mark Moussa, Matt Brandt, Daniel Rogers, Bethany P. Theiling, Shannon Bull, James MacKinnon, Timothy Chase, Ethan Haengel

<https://digitalcommons.usu.edu/smallsat/2023/all2023/139>

SmallSat, 2023

Human Adaptations to Multiday Saturation on NASA NEEMO

Andrew P. Koutnik, Michelle E. Favre, Karina Noboa, Marcos A. Sanchez-Gonzalez, Sara E. Moss, Bishoy Goubran, Csilla Ari, Angela M. Poff, Chris Q. Rogers, Janine M. DeBlasi, Bishoy Samy, **Mark Moussa**, Jorge M. Serrador, Dominic P. D'Agostino

10.3389/fphys.2020.610000

Frontiers in Physiology, 2021

SKILLS & INTERESTS

- **Technologies:** Python, PyTorch, TensorFlow, JAX, Keras, Hugging Face, NumPy, Pandas, scikit-learn, MLflow, FastAPI, React Native, Expo, AWS, Docker, CUDA, TFLite, ExecuTorch; deep learning (CNNs, LSTMs, Transformers, Bayesian & multimodal), model quantization, edge/real-time inference
- **Research:** Principal Investigator, Proposal Writing (PI-led funded NASA research), Technical Writing (first-author papers, conference abstracts, posters)
- **Interests:** Scuba Diving (training to be a Divemaster), Running (training for a marathon), Language Learning, Farming, Piano