ISABELLA HUMPHREY

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PROFESSIONAL SUMMARY

Machine learning engineer and Principal Investigator specializing in generative modeling, physics-informed learning, and multi-modal sensor data for defense applications. Principal Investigator for DON SBIR Topic N251-039 Phase I (Contract N00024-25-C-S246), in which she developed a physics-informed diffusion framework that integrates ray-based acoustic propagation parameters into the training objective for sonar signal generation. Research background in generative and semi-supervised learning from partially labeled data, underwater sensing and calibration, and temporal analysis of video sequences, with four peer-reviewed publications. Experience serving as Principal Investigator for federally funded R&D across USAF, OSD, and NAVSEA programs.

EDUCATION

Georgia Institute of Technology, Atlanta, GA
Master of Science, Computer Science (part-time), expected December 2027

University of Georgia, Athens, GA
Bachelor of Science, Computer Science (concentration in Artificial Intelligence and Data Science), August 2023

TECHNICAL EXPERTISE

- **Generative modeling:** diffusion models, variational autoencoders, physics-informed loss design and regularization
- **Learning from limited labels:** semi-supervised, weakly supervised, and active learning; deep metric learning
- **Sensing modalities:** mid-frequency acoustic, visual, depth (RGB-D), hyperspectral, and video data
- **ML infrastructure:** Python, AWS, end-to-end ML pipelines, microservice architectures for secure DoW cloud deployment
- **Program leadership:** DoW Principal Investigator, Government technical interface, federal proposal development (SBIR, STTR, NSF, DoW)

PROFESSIONAL EXPERIENCE

Analatom Inc., Athens, GA
Principal Investigator and Technical Project Manager, February 2024 – present

- Principal Investigator, DON SBIR Topic N251-039 Phase I. Developed a physics-informed diffusion modeling framework for one-dimensional sonar signal generation that integrates acoustic parameters from ray-based propagation models directly into the training objective. Demonstrated improved alignment with expected direct-path arrival times and reduced variance in physically relevant features, without destabilizing generated amplitudes or degrading signal quality.
- Leads the OSD-funded Automated Inspection using Deep Learning effort and additional DoW-sponsored R&D programs in AI and computer vision for defense systems.
- Developed end-to-end AI pipelines for high-frequency acoustic, visual, and hyperspectral sensing modalities, and designed microservice-based architectures for secure DoW cloud deployment.
- Serves as Principal Investigator and project manager for federally funded defense research across DoW branches; manages execution, schedules, technical reporting, and contract deliverables, and serves as the technical interface to Government program managers, subcontractors, and commercialization partners.
- Prepares and submits federal research proposals, including SBIR, STTR, NSF, USSF, DoN, DoE, and USAF solicitations.

University of California, San Diego, San Diego, CA
Visiting NSF Researcher, June 2022 – August 2022

- Developed and calibrated an underwater RGB-D camera system that uses AI to count fish and estimate their length, supporting the Semmens Lab and the Coastal California Fishery Research Program.
- Collected and analyzed underwater video and image data for fishery conservation research.
- Second author, “Underwater Depth Calibration Using a Commercial Depth Camera,” ACM WUWNet 2022.

Quinn Research Group, University of Georgia, Athens, GA
Undergraduate Research Assistant, October 2019 – January 2023

- Developed a modular generative pipeline for analyzing video of ciliary motion to support diagnosis of ciliopathies. The model analyzed frame-to-frame motion patterns to identify novel degenerative cilia conditions despite a lack of annotated data, producing quantifiable measures of subtle phenotypic differences while reducing reliance on expert labor.
- Extended deep metric learning with variational autoencoder components to permit training on semi-supervised datasets, showing how generative modeling can exploit unlabeled data and incorporate prior knowledge into training.
- Developed segmentation methods to detect cilia in biomedical imaging video from weakly supervised data.
- Mentored and trained new research group members on technical workflows and research methods, and contributed to group publications.

PUBLICATIONS

- “Incorporating Task-Agnostic Information in Task-Based Active Learning Using a Variational Autoencoder.” SciPy 2022.
- “Variational Autoencoders for Semi-Supervised Deep Metric Learning.” SciPy 2022.
- “Underwater Depth Calibration Using a Commercial Depth Camera.” ACM WUWNet 2022 (second author).
- “Unsupervised Representation of Cilia Video Using a Modular Generative Pipeline.” SciPy 2020.