

Angel Andres Daruna

Curriculum Vitae

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Professional Summary

Ph.D.-trained AI/ML research scientist with a track record of excelling in federal agency funded R&D projects (e.g., DARPA) at the intersection of computer vision, geospatial intelligence, and multimodal fusion. I specialize in building scalable, interpretable ML systems using state-of-the-art techniques such as transformers, multimodal fusion, self-supervised learning, LoRA, RAG, vector DB, and LLM agents.

Skills:

Software:	Python, PyTorch, Lightning, Hydra, Github, Docker, Kubernetes, ROS, Ubuntu Linux, Gazebo, SQL
Machine Learning:	Multimodal Fusion, Explainable AI, Transformers, Agentic AI, Uncertainty Estimation, Graph Embedding, Continual Learning
Hardware:	Prototyping field robots with microcontrollers, FPGAs, various depth and image sensors, motors, many DoF arms, and others
Research:	Data exploration, problem identification, literature review, study design and planning, statistical testing, and user studies
Language:	English (native) and Spanish (proficient)

Education

2022	Ph.D. in Robotics Georgia Institute of Technology - Atlanta, GA Advisor: Sonia Chernova Committee: Matthew Gombolay, Zsolt Kira, Devi Parikh, Mohan Sridharan GPA: 3.76
2021	M.S. in Computer Science Georgia Institute of Technology - Atlanta, GA GPA: 3.76
2015	B.S. in Computer Engineering Georgia Institute of Technology - Atlanta, GA GPA: 3.91
2013	B.S. in Computer Engineering Florida International University - Miami, FL GPA: 3.69 (transfer)

Research Experience

2024

Manager:
Han-Pang Chiu
Remote, FL

Critical Mineral Assessment with AI Assistance

- Used Machine Learning (ML) algorithms to automate Mineral Prospectivity Mapping (MPM) by learning associations between geospatial data and few historical as part of the DARPA CriticalMAAS program
- Our novel MPM approach uses a masked image modeling framework to pretrain a backbone neural network in a self-supervised manner using unlabeled geospatial data alone
- Served as a technical lead, guiding our team to consistently dominate in performer evaluations and integrate our tool within USGS mineral assessment workflows

2023

Manager:
Han-Pang Chiu
Remote, FL

Worldwide Visual Geolocation

- Developed a state-of-the-art worldwide visual geolocation pipeline using a transformer based multimodal fusion architecture as a subcontractor for NGA
- The implemented pipeline scales to datasets of tens of millions images using multi-GPU training through docker and Kubernetes

2022

Manager:
Han-Pang Chiu
Remote, FL

Deep Learning Uncertainty Quantification

- Developed and published a new approach to estimate deep neural network predictive uncertainty as part of the DARPA Enabling Confidence program
- Posed uncertainty propagation as a non-linear optimization problem using factor graphs to balance the benefits of sampling and analytical propagation techniques
- Evaluated with statistical testing across multiple experiments that included three datasets and two neural network architectures, observing statistically significant improvements

2021

Advisor:
Sonia Chernova
Atlanta, GA

Explainable Knowledge Graph Embedding

- Developed an inference reconciliation framework to provide NL explanations of a robot's decision-making supported by graph embedding predictions using a pedagogical XAI approach
- Leveraged subgraph feature extraction and decision trees to explain graph embedding inferences to non-experts in NL, enabling users to correct over 86% of erroneous graph facts
- User studies showed user's preferred our explanations and feedback from users significantly improved graph embedding fact prediction performance and robot task performance

- Clearly communicated results in manuscript submitted to IEEE IROS 2022 with supplementary open-source code on GitHub

2020

Advisor:
Sonia Chernova
Atlanta, GA

Continual Knowledge Graph Embedding

- Identified and defined a new research problem within knowledge graph embedding by relaxing common assumptions
- Developed a modular machine learning pipeline using Python and Pytorch that generated data and implemented, trained, and evaluated 5 continual learning techniques for graph embeddings
- Used a variety of metrics that tracked scalability, learning speed, and inference performance to quantitatively compare each technique, for example Deep Generative Replay using a Variational Auto-Encoder
- Extracted actionable conclusions from experiments and clearly communicated them in a manuscript published in RA-L 2021 with supplementary open-source code on GitHub

2020

Advisor:
Sonia Chernova
Atlanta, GA

Robust One-shot Task-Plan Execution

- Developed a simulation pipeline using ROS and VirtualHome simulator to sample realistic household environments
- Implemented, trained, and evaluated multiple machine learning representations (word embeddings, knowledge graph embeddings, markov-logic networks) through ablation studies using a dataset of over 8000+ sampled simulations
- Deployed models for validation in 50 robot experiments that integrated mapping, navigation, obstacle avoidance, object detection and segmentation, and arm motion planning
- Derived data-driven insights from experiments that were presented in a manuscript published at ICRA 2021

2019

Challenge Rep:
Sarah Elliott
Montreal, Canada

Winning FetchIt! Mobile Manipulation Challenge

- Worked closely with a diverse team to build a task execution software stack that was entered in an autonomous manufacturing and assembly challenge in ICRA, 2019
- Wrote an open-source computer vision ROS package (rail_mesh_icp) that was used to approximate pose estimates of multiple physical parts with 3mm of clearance for peg-and-whole mobile manipulation
- Aided in design of- and integration of point-to-point navigation stack with collision mapping, which was used all 45 minutes of the challenge enabling safe, autonomous base navigation
- The integrated system won first prize, which was a free Fetch

mobile manipulator; provided supplementary open-source code on GitHub

2018

Advisor:
Sonia Chernova
Atlanta, GA

Robot Common-Sense Embedding

- Analyzed weaknesses within existing approaches to modeling semantic knowledge graphs for robotics applications
- Developed a machine learning pipeline using C++ and Python that applied knowledge graph embedding to the problem of modeling semantic knowledge graphs for robotics applications
- Quantitatively evaluated our framework against existing approaches in regards to inference performance and scalability
- Our method empirically advanced the state-of-the-art and results were presented in a manuscript published in ICRA 2019, with supplementary open-source code on GitHub

2018

Director:
Greg Durgin
Atlanta, GA

Mentored First Place Undergraduate Research Project

- Guided an undergraduate team of 4 to build a SLAM and semantic mapping software system for robot autonomy in home environments
- System design integrated mapping with object detection and segmentation to provide robots a semantic overlay of a 3D grid map
- Assisted integrating a VLP-16 LiDAR in ROS with simulation and on a mobile manipulator robot for navigation and 3D mapping

Publications

1. **Daruna, Angel**, et al. "Enabling Scalable Mineral Exploration: Self-Supervision and Explainability." 2024 IEEE International Conference on Big Data (BigData). IEEE, 2024.
2. **Daruna, Angel**, et al. "GFM4MPM: Towards Geospatial Foundation Models for Mineral Prospectivity Mapping." Proceedings of the 32nd ACM International Conference on Advances in Geographic Information Systems. 2024.
3. Chiu, Han-pang, Yi Yao, **Angel Daruna**, Yunye Gong, Abhinav Rajvanshi, and Giedrius Burachas. "UNCERTAINTY ESTIMATION FOR NEURAL NETWORKS USING GRAPHICAL REPRESENTATION." U.S. Patent Application No. 18/672,221.
4. **Daruna, Angel**, Devleena Das, and Sonia Chernova. "Explainable Knowledge

Graph Embedding: Inference Reconciliation for Knowledge Inferences Supporting Robot Actions." *2022 IEEE International Conference on Intelligent Robots and Systems (IROS)*. Under review.

5. **Daruna, Angel**, Mehul Gupta, Mohan Sridharan, Sonia Chernova, "Continual Learning of Knowledge Graph Embeddings." *2021 IEEE Robotics and Automation Letters (RA-L)*. IEEE, 2021.
6. Liu, Weiyu, Dhurv Bansal, **Angel Daruna**, and Sonia Chernova. "Learning Instance-Level N-Ary Semantic Knowledge At Scale For Robots Operating in Everyday Environments." pending publication, *Robotics: Science and Systems 2021*. 2021.
7. **Daruna, Angel**, Lakshmi Nair, Weiyu Liu, Sonia Chernova, "Towards Robust One-shot Task Execution using Knowledge Graph Embeddings." *2021 IEEE International Conference on Robotics and Automation (ICRA)*. IEEE, 2021.
8. Liu, Weiyu, **Angel Daruna**, and Sonia Chernova. "Cage: Context-aware grasping engine." *2020 IEEE International Conference on Robotics and Automation (ICRA)*. IEEE, 2020.
9. Liu, Weiyu, **Angel Daruna**, Zsolt Kira, and Sonia Chernova. "Path ranking with attention to type hierarchies." *Proceedings of the AAAI Conference on Artificial Intelligence*. Vol. 34. No. 03. 2020.
10. Chernova, Sonia, Vivian Chu, **Angel Daruna**, Haley Garrison, Meera Hahn, Priyanka Khante, Weiyu Liu, and Andrea Thomaz. "Situating bayesian reasoning framework for robots operating in diverse everyday environments." *Robotics Research*. Springer, Cham, 2020. 353-369.
11. **Daruna, Angel**, Weiyu Liu, Zsolt Kira, Sonia Chernova. "Robocse: Robot common sense embedding." *2019 International Conference on Robotics and Automation (ICRA)*. IEEE, 2019.
12. Siddhartha Banerjee, **Angel Daruna**, David Kent, Weiyu Liu, Jonathan Balloch, Abhinav Jain, Akshay Krishnan, Muhammad Asif Rana, Harish Ravichandar, Binit Shah, Nithin Shrivatsav. "Taking Recoveries to Task: Recovery-Driven Development for Recipe-based Robot Tasks." *Proceedings of International Symposium of Robotics Research*. IFRR, 2019.

Industry Experience

2022 - present
Manager:
Han-Pang Chiu
Remote, FL

Advanced Computer Scientist @ SRI International

► Worked with multidisciplinary technical teams and managers to progress Machine Learning technologies through ideation, design, development, evaluation, deployment, and transition

- Co-authored multiple conference articles, white papers, RFIs, and proposals for DARPA, NGA, and ARPA-E agencies
- Communicated with government clients through presentations and meetings, understanding and meeting client expectations

2021

Manager:
Han-Pang Chu
Remote, GA

Vision and Language Navigation Intern @ SRI International

- Developed a VLN pipeline in Pytorch that hierarchically combined object, natural language, and scene features using Gated Attention Network (Transformer-like) layers
- Trained the scalable pipeline via imitation and reinforcement learning on GPU clusters using Docker, Tensorboard, and Kubernetes
- Communicated progress to team members through weekly presentations using data visualizations and presented final results to the division

2017

Manager:
Carlos Montesinos
Santa Clara, CA

Computer Vision and Drone Intern @ Intel

- Designed the system architecture and built 3 prototype iterations for a proof-of-concept drone application using ROS Python that leveraged real-time deep learning architectures (MobileNet) to do object detection in Tensorflow
- Analyzed ROS logs from field testing on the Intel Edison and RealSense hardware to debug system errors and optimize performance
- Mentored more junior team members. Together with senior members, co-authored and submitted two Invention Disclosure Forms related to our work and presented the applications to the Intel Drone Group VP, Anil Nanduri

2016

Manager:
Chris Lightcap
Ft. Lauderdale, FL

Software Engineer @ ADEX, MagicLeap

- Optimized and designed evaluation of Kalman filtering 6-DoF pose estimation algorithm for augmented reality game controllers
- Evaluated development microcontrollers against a high accuracy pose estimation system, the Optotrak Certus, and analyzed pose trajectory logs with various filtering parameter settings to optimize high-accuracy pose estimation performance
- Wrote a C++ program with an OpenCV user interface that displays real-time plots to assist users to tune filters for game controllers

Distinguished Awards:

2016-2021

National Science Foundation
Graduate Research Fellowship Program

2016-2018	The National GEM Consortium GEM Full Fellow - Intel Sponsored
2016-2020	Goizueta Foundation Goizueta Foundation Graduate Fellowship Program
2016-2020	Georgia Tech President's Fellowship