

# Draper Artificial Intelligence / Machine Learning Research Interests

## University Programs Point of Contact

Dr. Brenan McCarragher, CTO  
617.692.0932  
[education@draper.com](mailto:education@draper.com)

## Technical Point of Contact

Margaret Duff  
617.620.3907  
[mduff@draper.com](mailto:mduff@draper.com)

## Introduction

Draper uses Artificial Intelligence and Machine Learning to provide critical capabilities to our advanced systems in the space, security, and military domains. However, an overarching challenge of using AI/ML in these domains is sparse or incomplete data sets. Draper seeks methods to advance the state of the art in this field.

### *About Draper Laboratory ([www.draper.com](http://www.draper.com))*

*Draper is an independent, not-for-profit corporation, chartered to work on problems in the national interest. Draper is **seeking collaborative research partners from universities** to further the state of the art in key technologies of mutual interest. Research Whitepapers describing Draper's technology interests and Technical Points of Contact can be found on the Draper Scholars webpage ([Draper Scholar Program | Draper](#)). The Draper Scholars Program funds thesis-bearing MS and PhD students at partner universities as one of the effective ways to progress the technology. Other means of collaborative research (e.g. joint proposals, sabbaticals, etc.) are also encouraged. Please contact [education@draper.com](mailto:education@draper.com) if you have further questions.*

## Research Interests

### 1. *AI/ML with sparse or incomplete data sets*

Training successful AI/ML algorithms, especially deep learning models, requires large, comprehensive data sets that are similar to operation use conditions. AI/ML is significantly less successful when the data sets are sparse or missing critical features or data points that occur during deployment. And in many of our domains of interest, it is not feasible to generate large sets of training data because there are historically few examples or the events of interest are infrequent or unique. In particular, large might not just mean a significant number of data elements, but a sufficient sampling of the event/target of interest. For many of Draper's use cases (e.g., nuclear events, terrorists attacks, pandemic outbreaks) these events, and the associated data are rare. We are looking for novel approaches to AI/ML when only sparse or incomplete data sets are available. Example applications include:

- a) **Collaborative Autonomy** - using two or more autonomous agents (including Human-Machine and Machine-Machine Teaming) to work together towards a common goal.
  - Collaborative control, tasking, navigation, data fusion, or decision making
  - Mission planning, mission management, and decision support
  - Wargaming and simulation
- b) **Generative Design** – improving manual, resource-intense optimization sweeps to create electrical, mechanical, or integrated hardware designs.
  - Photonics gratings for miniaturized LIDAR

- Semiconductors or microelectronics
  - Electromechanical (e.g., RF) systems
  - Validation and verification
- c) **Digital Signal AI** – using digital signal analysis to attack, protect, or support sensor, computing, or communication systems.
- Cognitive electronic warfare
  - Cybersecurity
  - Finding signal in noisy data
- d) **Biosecurity** – identifying and responding to threats and events that have biological causes or biological consequences.
- Chemical, biological, radiation, and nuclear event prediction, detection, and mitigation
  - Pandemic detection and response
  - Organ modeling / drug testing
  - Physiological signals and sensing

We would be targeting PhD students for the development of novel approaches; and MS students for the application of existing approaches to specific problems of interest to Draper. Students with concentration in machine learning, with interest in these domains, or students with concentrations in domains (e.g., biologists) with interest in machine learning are of equal consideration.