IAF SPACE OPERATIONS SYMPOSIUM (B6)
Interactive Presentations - IAF SPACE OPERATIONS SYMPOSIUM (IP)

Author: Mr. Christopher Heistand
The John Hopkins University Applied Physics Laboratory, United States, christopher.heistand@jhuapl.edu

Mrs. Amy Alford
JHU Applied Physics Laboratory, United States, amy.alford@jhuapl.edu
Mrs. Elizabeth Bathrick
Johns Hopkins University Applied Physics Laboratory, United States, liz.bathrick@jhuapl.edu
Mr. Dmitriy Bekker
Johns Hopkins University Applied Physics Laboratory, United States, dmitriy.bekker@jhuapl.edu
Dr. Joshua Broadwater
Johns Hopkins University Applied Physics Laboratory, United States, joshua.broadwater@jhuapl.edu
Mr. Adam Byerly
Johns Hopkins University Applied Physics Laboratory, United States, adam.byerly@jhuapl.edu
Dr. Christopher Gifford
JHU Applied Physics Laboratory, United States, Chris.Gifford@jhuapl.edu
Dr. Musad Haque
The John Hopkins University Applied Physics Laboratory, United States, Musad.Haque@jhuapl.edu
Dr. Amy Haufler
Johns Hopkins University Applied Physics Laboratory, United States, amy.haufler@jhuapl.edu
Dr. Karl Hibbitts
Johns Hopkins University Applied Physics Laboratory, United States, Karl.Hibbitts@jhuapl.edu
Mr. Michael Malinowski
JHU Applied Physics Laboratory, United States, michael.malinowski@jhuapl.edu
Mr. Justin Thomas
Johns Hopkins University Applied Physics Laboratory, United States, justin.thomas@jhuapl.edu
Ms. Rebecca Williams
JHU Applied Physics Laboratory, United States, rebecca.williams@jhuapl.edu
Ms. Kiley Yeakel
Johns Hopkins University Applied Physics Laboratory, United States, kiley.yeakel@jhuapl.edu
Ms. Michelle Chen
The John Hopkins University Applied Physics Laboratory, United States, michelle.chen@jhuapl.edu

ONBOARD ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FOR ENHANCING SMALLSAT CONSTELLATIONS

Abstract

Earth orbiting missions are being designed around constellations of small satellites and CubeSats with greater heterogenous sensor capability, data volume, and complexity (of joint) operations than ever before. In parallel, sensors continue to become smaller and require less power, yet generate a much larger data volume. With all this space-based capability, it is time to apply mature Artificial Intelligence (AI) from ground systems and distribute it across the heterogenous sensor constellations. A benefit of a distributed

intelligent system is that data can be triaged onboard, leaving communications links open for the time critical data to be downlinked. Understanding capabilities of neighboring satellites enables autonomous cueing of relevant sensors and coordinated data acquisition amongst the satellites. This coordinated inter-satellite operation facilitates capturing time-dependent natural phenomena ranging from understanding weather to monitoring natural disasters that could otherwise be missed or require additional spacecraft resources such as extended observation times and recorded data volume.

As with all mission designs, there are trades to be analyzed. What is the optimal distribution of AI? What algorithms can actually be implemented onboard the satellite? What is the best combination of human and machine teaming? Which decisions can be made without human intervention? The Johns Hopkins University Applied Physics Laboratory is developing a capability that enables

1. these trades to be evaluated,
2. rapid prototyping of these concepts to demonstrate efficacy using an infrastructure that can easily be deployed onto future space avionics and ground systems, and
3. a flexible prototype that facilitates integration and evaluation of different sensor types and machine learning algorithms.