

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

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One key aspect in the development of HWO is the early deployment of artificial intelligence (AI) and machine learning (ML) to enhance mission science and operations. Our subtask group is part of the HWO AI/ML working group and focuses on AI and ML for mission operations. Our task group seeks to educate other HWO working groups about AI and ML capabilities for mission operations, investigate how to bridge technology gaps, and enable new capabilities particularly in the areas of observational scheduling, instrument health monitoring, and downlink operations.

We focus on mission tasking / scheduling both for mission analysis in development and operations. AI and ML for mission scheduling includes: tools to support proposal calls and review, ensuring fairness in calls for proposals, community peer reviews and ease workloads, as well as in-flight and ground software development (e.g., using natural language processing (NLP) to support process automation from requirements). AI and ML for the mission's development and operations include 1) anomaly detection and prediction

(from onboard and ground based tools) to monitor the spacecraft's health, 2) ground-based automated scheduling for mission operations including long-term and short-term planning and maintenance, and 3) flight system flexible execution (as flight proven for Spitzer and JWST) to enable robust execution despite execution variations, and 4) data analysis for prioritization (e.g., real-time data evaluation leading to autonomous actions and adjustments, high-priority identification, onboard data compression, etc.).

Incorporation of ML and AI will enable HWO to address the major science questions related to exoplanet characterization, general astrophysics, and solar system exploration and also extend the boundaries of space mission technologies.

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