SYNOPSIS: Addressing the Data Bandwidth Barrier for Interplanetary Missions

For many missions, the ability to collect data far outstrips the ability to transmit it to Earth. This is especially true for interplanetary science missions beyond Mars. For these missions, science autonomy algorithms are of great value because of their ability to summarize and prioritize scientific data onboard the spacecraft; they provide a means to **maximize the science return of a mission in the face of severe data transmission constraints.** To coordinate downlink between multiple autonomously-enabled instruments, we built SYNOPSIS (Science Yield improvemeNt via Onboard Prioritization and Summary of Information System).

There are several examples of such autonomy systems at JPL including the Ocean Worlds Life Surveyor (OWLS) project for detecting life on Ocean Worlds, Responsive Onboard Science for Europa Clipper, and Content-based On-board Summarization to Monitor Infrequent Change (COSMIC) for Mars exploration. While future missions will benefit from the development of these algorithms, there is not yet a way to systematically deploy and operate multiple algorithms on one mission. This is a vital need as the volume and complexity of data acquired by spacecraft continues to increase.

SYNOPSIS aims to provide a reusable, easy-to-use framework to facilitate deployment of multiple onboard science autonomy algorithms. It acts to integrate and prioritize data products even when data from multiple autonomously-powered instruments is present. Specifically, SYNOPSIS:
1. Enables multi-instrument prioritization based on a tunable combination of utility and diversity. Utility prioritization favors data products with high intrinsic value (according to the science team) while diversity prioritization favors data products with "new" or "different" content.
2. Provides a rules-based mechanism to enforce inter-instrument relationships during data prioritization. For example, this is valuable when contextual and high-resolution instruments sometimes measure the same phenomenon.
3. Is being integrated into core Flight Software (cFS) and is currently integrated into the F-Prime flight software packages. This lowers the bar for future mission inclusion.

The SYNOPSIS code base is open source and we aim to provide a standard interface for other research groups to improve or reuse science autonomy algorithms or develop new ones to fit within the same framework.