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AN AI-BASED GOAL-ORIENTED AGENT FOR ADVANCED ON-BOARD AUTOMATION

Abstract

In the context of fierce competition arising in the space economy, the number of satellites and constellations that will be placed in orbit is set to increase considerably in the upcoming years. In such a dynamic environment, raising the autonomy level of the next space missions is key to maintaining a competitive edge in terms of the scientific, technological and commercial outcome.

We propose the adoption of an AI-based autonomous agent aiming to fully enable spacecraft's goal-oriented autonomy. The implemented cognitive architecture collects input starting from the sensing of the surrounding operative environment and defines a low-level schedule of tasks that will be carried out throughout the rest of the mission. In this regard, the agent provides a planner module designed to find optimal solutions that maximize the outcome of the pursued objective goal. The autonomous loop is closed by comparing the expected outcome of these scheduled tasks against the real environment measurements.

The entire algorithmic pipeline was tested in a simulated operational environment, specifically developed for replicating inputs and resources relative to Earth Observation missions. The autonomous reasoning agent was evaluated against the classical, non-autonomous, mission control approach, considering both the quantity and the quality of collected observation data in addition to the quantity of the observation opportunities exploited throughout the simulation time. The preliminary simulation results point out that the adoption of our software agent enhances dramatically the effectiveness of the entire mission, increasing and optimizing in-orbit activities, on the one hand, reducing events' response latency (opportunities, failures, malfunctioning, etc.) on the other.

In the presentation, we will cover the description of the high-level algorithmic structure of the proposed goal-oriented reasoning model, as well as a brief explanation of each internal module's contribution to the overall agent's architecture. Besides, an overview of the parameters processed as input and the expected algorithms' output will be provided, to contextualize the placement of the proposed solution. Finally, an Earth Observation use case will be used as the benchmark to test the performances of the proposed approach against the classical one, highlighting promising conclusions regarding our autonomous agent's adoption.