Paper ID: 69212
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IAF SPACE OPERATIONS SYMPOSIUM (B6)
Innovative Space Operations Concepts and Advanced Systems (2)

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OVERVIEW OF THE AI-BASED FAULT MANAGEMENT CONCEPT ONBOARD THE UNIBW M SERANIS MISSION

Abstract

Utilization of novel technology in space is nowadays a common and versatile approach. Many technological advancements are applied in space to provide for example global communication networks and Earth observations. However, as the number of operational satellites increases, the amount of faults to be detected, isolated, and resolved by ground operators reaches a very critical point. Under this condition, the operational time, mission lifetime, and health-monitoring capabilities of satellites decreases. In addition, common preventive measures such as redundant hardware and software on-board satellites can be demanding with respect to the resources required.

The AI4FDIR system that is part of the UniBw M SeRANIS mission is presenting an innovative approach to Fault Detection, Isolation, and Recovery (FDIR). The goal of this strategy is to predict fault events and detect anomalies in the satellite telemetry and payload data onboard. Once the fault event is predicted or an anomaly is detected, the on-board AI4FDIR system traces the source of the fault by explaining the prediction and analyzing potential root causes. After the predicted fault and/or anomaly is isolated and identified, optimal prevention and recovery actions are selected based on the current state of the spacecraft, orbit events, and general system capabilities. With this approach the AI4FDIR system closes the gap between reactive FDIR and predictive maintenance concepts and increases the level of autonomy of spacecraft. With this, the operational time and mission lifetime of satellites will be increased, the reliability and performance factors of satellites enhanced, and costs per satellite decreased.

This paper presents the concept of the AI4FDIR system onboard the SeRANIS mission together with its operational concept and required interfaces. Moreover, it provides a comparison of state-of-the-art AI methods and a preliminary selection of methods to be implemented and tested during the development phase of the AI4FDIR system.