IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (2)

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CLASSIFYING AUTONOMOUS SPACE SYSTEM ARCHITECTURES FOR SATELLITE MISSION OPERATIONS

Abstract

The operation of satellites requires engineers to evaluate thousands of telemetry parameters in order to assess the system's state of health. In case of fault or failure, the appropriate reaction is selected from hundreds of flight control procedures after reviewing countless log files and searching through databases.

In this respect, the core expertise of the mission operations technology group (MBT) is the product development for satellite telemetry analysis and visualization to provide context and modern support tools to the engineers and operators. The framework under development features long term telemetry analysis, anomaly detection for single and multiple parameters, pattern matching and telemetry forecasts in order to enhance operational performance by granting direct access to information without tedious searching. In the frame of the Cognitive Autonomy for Space Systems (CASSy) initiative, the MBT group investigates the implications of higher level on-board autonomy for the operations engineers. The question at hand is: how do the above described challenges of operating traditional spacecraft scale to operations of (highly) autonomous architectures?

The goal of the proposed paper is to explore the autonomy landscape ground-based and on-board in order to address the needs of operators to close the gap between autonomous on-board reactions on all possible levels and the comprehensive perception of the resulting system state by the engineer on ground. The paper provides a review of applied autonomy system levels, methods and application on ground and on-board. A systematic classification of spacecraft autonomy on both space and ground segments results in a taxonomy that matches then the identified operational needs to the respective technique. Examples from daily operational life validate the generic approach. Finally, the paper concludes with respective developments in advanced operational tools and architectures to provide the operating engineer with system context to enhance the situational awareness.