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CONCEPT, ARCHITECTURE AND SIMULATION CONSIDERATIONS FOR A COGNITIVE RECOVERY UNIT ON-BOARD INTERPLANETARY SPACECRAFT

Abstract

For space missions and system operations, automation and autonomy have become growingly important in the last decade. The main factors that call for advanced automation on-board interplanetary spacecraft are latencies in communication, the uncertain environmental conditions that are to be experienced by the spacecraft and the operational cost. The technological progress in computing power on the other hand enables the implementation of such advanced concepts and systems on-board future spacecraft.

Traditional fault management methods on-board spacecraft seem to be characterized by pre-defined, hard-coded routines and safe mode events in case of unanticipated faults or failures that means effectively, loss of operational time. This paper proposes a concept how to complement existing fault management methods with an advanced system for goal-based mission continuation, above all in case of unexpected failure.

The so-called “cognitive recovery unit” is a new concept for operating highly complex, interplanetary spacecraft based on knowledge about the system and its operational capabilities represented on-board. Its goal is to reduce the number of safe mode events. In this manner, the operator’s workload and thus, overall operational cost can potentially be decreased while the spacecraft’s operational time could be optimized to improve mission output in quality and quantity.

This paper introduces the concept, design and architecture of the “cognitive recovery unit”. By means of a simulation case study, the applicability of the cognitive recovery unit in the space domain shall be demonstrated. A relevant interplanetary mission scenario is designed and six respective test cases are derived and presented. Considerations to create a simulation environment for the described mission scenarios are presented and discussed. First visualizations and simulation results will conclude the paper.