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SIMULATION FOR GOAL-BASED MISSION CONTINUATION ON-BOARD INTERPLANETARY SPACECRAFT

Abstract

ESA's 5th cornerstone mission BepiColombo to the innermost planet, Mercury, serves as an example and case study for an interplanetary spacecraft that has to operate in a particularly harsh environment. After seven years of flight, there will only be one year of nominal scientific mission. To ensure the maximum scientific benefit within this limited time, a high level of on-board autonomy would be beneficial to avoid unnecessary safe mode events and ensure safe mission continuation even in case of no link to ground. By means of this simulation and testing concept, the increasing resilience by enhanced self-awareness of the spacecraft in the fault management domain on system level is demonstrated.

The work to be presented introduces the respective simulation concept, its set-up and demonstrates its possibilities.

For simulation purposes, a test concept is introduced that features a goal-based mission continuation strategy with eigth levels of increasing complexity and fault/failure scenarios implemented in a cognitive recovery unit.

The simulation consists of three parts, each of which will be presented in detail: the system simulation of all relevant spacecraft subsystems, the independent goal-based mission continuation knowledge base and processing as well as the graphical user interface to introduce faults and failures and control the simulation process.

First results of the simulation including parameter variations and sensitivity analyses will be presented. An evaluation of the results and considerations for future developments (e.g. implementation of other suitable AI techniques) conclude the paper.