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ADIA-L: IMPLEMENTATION AND INTEGRATION OF A MODEL-BASED AUTONOMOUS DIAGNOSTIC SYSTEM AS PAYLOAD FOR THE NANOSATELLITE MISSION SONATE

Abstract

ADIA-L is an autonomous diagnostic system for small satellites derived from its parent project ADIA++ (funded by the German Ministry of Economoic Affairs and Energy through the German Aerospace Center DLR, FKZ 50RM1524) intended for first-time operation aboard the nanosatellite SONATE (FKZ 50RM1606) which is currently undergoing design work at the Professorship of Space Technology of the University of Würzburg, Germany, and is slated for launch in early 2019.

As one of two main payloads (the other being ASAP – FKZ 50RM1208 – , an autonomous image sensor), ADIA-L's main mission objective is to test and evaluate the model-based diagnostic software developed during the course of ADIA++ based on real-time online housekeeping frames provided by SONATE's onboard computer.

ADIA-L, as an embedded hardware port of the PC-based ADIA++ software, uses the same model-based diagnostic algorithm whereby an is-ought-comparison between actual sensor data generated by SONATE and its predicted state generated by a quantitative simulation of the spacecraft's subsystems and components is performed. Diagnostic activity encompasses both the detection of symptoms (either a discrepancy between e.g. a rate sensor measurement and its simulated counterpart, an anomalous trend on a user-defined measurement time series which ADIA-L constantly monitors or a heuristic formulation of a system fault explicitly given by the user) and the derivation of diagnoses thereof (i.e. a list of components responsible for the symptoms).

The overall experiment scenario contains a multitude of different validation experiments ADIA-L will undergo as part of the SONATE mission, among them both tests of standard functionalities such as

interface operability as well as detailed analytic tests geared towards long-term diagnostic monitoring and sensor trend analysis of a real satellite.

ADIA-L is going to run onboard SONATE as a software application sustained by DLR's RODOS middleware on a dedicated hardware platform. The full paper will give a detailed account of the software's architecture and internal information processing pathways as well as its interfaces with SONATE's other subsystems, especially the onboard computer. Furthermore, a preliminary evaluation of ADIA-L's diagnostic capabilities based on housekeeping frames generated by our spacecraft simulation software Maru/Clockworks++ is going to be provided as well as a first analysis of the system's computational load as well as its power consumption in the context of its operation aboard SONATE.