

SPACE OPERATIONS SYMPOSIUM (B6)
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A FAULT DETECTION ISOLATION AND RECOVERY SYSTEM (FDIR) FOR AUTONOMOUS
SATELLITE OPERATION

Abstract

The recent success of small satellite missions lead to the establishment of low cost ground station networks (e.g. GENSO), which can be used to access a satellite from any distant location on Earth. In the scope of such academic ground station networks fully autonomous or teleoperated ground station equipment is desired, but due to the lack of proper monitoring and control capabilities still a significant amount of manpower is required for satellite operation. Especially in the scope of educational satellites dedicated staff for satellite operation is not foreseen. Thus, a system tailored for radio stations was implemented to provide the necessary functionality to detect and recover from anomalies in the ground station system.

The term Fault Detection Isolation and Recovery (FDIR) summarizes approaches which are used to handle conflicts or failures in a variety of systems, like computers, robots or satellites. The paper summarizes in the first part common techniques to derive concepts for failure detection in a structured way. These techniques were applied to the ground station at the University of Würzburg, the results from the theoretical analysis of such a typical radio station are presented to show the complexity of the analysis.

In the second part of the paper a detailed description of the design and the implementation of the developed FDIR approach are given. The approach is purely implemented in software, in that way the system can be easily adapted to other ground systems. The implemented system was verified with a small satellite launched in 2011. The system proved to be reliable and was able to track and record satellite telemetry autonomously over a long time period. The paper explains which failures occurred during operation and how the FDIR software handled them to revert back to normal operation. Hence, time as well as cost for operating the ground station could be minimized whereas its reliability and availability was increased.