IAF SYMPOSIUM ON FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS (A7)
Interactive Presentations - IAF SYMPOSIUM ON FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS (IP)

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FDIR STRATEGIES ON MISSIONS WITH HIGHLY SENSITIVE OPTICAL PAYLOADS

Abstract

Optical and infrared telescopes are main instruments in the scientific field of cosmology and astronomy missions, such as PLATO, Euclid, Herschel and Planck. Although these missions differ in their architectures and measurement principles, they all rely on payloads with sensors that are highly sensitive to thermal variation and Sun illumination, which could even lead to severe damages of the sensors and loss of mission. Depending on the payload configuration, a shutter for payload protection during launch and critical mission phases cannot be accommodated, leaving an open payload configuration for the complete mission, including the launch and contingency situations.

The combination of payload protection requirements and accommodation constraints calls for a specific FDIR design. The corresponding FDIR functions have to safeguard the payload for the entire mission, covering launch vehicle separation, orbital manoeuvres as well as nominal and contingency operations.

This paper provides a description of the driving requirements and arising challenges and presents technical solutions to deal with these payload driven FDIR requirements on the very characteristic example of ESA's last medium class mission, PLATO, for exoplanet transit and oscillation observation. . Measures include adaptation of the usual FDIR architecture and unit level redundancy concept as well as implementation of dedicated high level alarms and sensors.

The focus is put on interfaces and requirements to OBDH, OBSW and AOCS. The spacecraft needs to provide the capability to detect, isolate and recover system and unit failures or spacecraft state anomalies leading to unwanted angular velocities or orientations with high reliability and within an extremely short timeframe. This results directly in requirements concerning booting sequences, mode transitions or computer module switch-over procedures which are also described in this paper.

In addition, special attention is placed on the launcher separation phase, which is a critical mission phase concerning payload protection due to the launcher induced angular rates, clearance times and the spacecraft initialization process.