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SOLID-BORNE SOUND MEASUREMENT FOR THE INDEPENDENT EVENT DETECTION

Abstract

Failure detection and analysis is a very important aspect of unmanned and therefore remotely operated spaceflight missions. A dedicated failure detection system for every mechanical part would significantly increase the weight and complexity of a spacecraft. The goal of the SOMID experiment is to develop, build and flight test a failure detection system which monitors multiple components onboard a spacecraft regarding its correct function or causes of a possible malfunction. This includes components, which induce vibrations into the structure via mechanical switching processes. As every kind of mechanical event on a spacecraft induces micro-vibrations into its structure, solid-borne sound has been chosen as the source of information for SOMID. The experiment uses these micro-vibrations to detect and analyse various events. Accelerometers on the supporting structure and outer hull of the rocket measure generated specific events. Those events are created by two valves and a servomechanism which were mounted on the bulkhead of the experiment module. The piezo-based accelerometers are operational during the entire mission which allows recording of data from the valves and the servomechanism as well as every other kind of vibration caused during the different phases of flight. The measured data is stored on a flash data storage for post flight evaluation. Laboratory experiments that have been conducted before the launch of the rocket had already shown that every event shows specific characteristics within the frequency spectrum. This spectrum can be used as a method of failure detection on space vehicles through comparison with reference measurements. Using the system as a source of information about impacts of micro-meteorites and space debris is also possible with accelerometers mounted on solar panels. The SOMID experiment has been flight tested on the REXUS-12 sounding rocket on the 19th of March 2012. From the scientific point of view the flight of the SOMID experiment was a success. All recorded data from nine minutes and 30 seconds before Lift-Off until payload impact could be recovered from the onboard data storage. All events in the experiment timeline were triggered at the right time during flight. A first look at the data with a prepared evaluation routine shows, that the quality of the measurements is as expected. In the following months further evaluation will be undertaken to meet the primary scientific goal of the experiment of monitoring all predefined mechanical events on the rocket.