IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Interactive Presentations - IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (IP)

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NEW BATTERY MODEL FOR CONSOLIDATING A HEALTH MONITORING SYSTEM MODEL OF A REUSABLE LAUNCHER POWER HARNESS

Abstract

Being able to monitor the state of health of reusable launcher systems is a major concern. A health monitoring system (HMS) should provide a reliable information on the system's integrity and guide the maintenance process with the most accurate information possible, in the shortest possible time, with the smallest possible overhead in terms of size, weight and power consumption (SWaP).

Electrical harnesses are critical components, and several failures implying this function were already reported in launchers history. Cables and connectors are deployed through long ducts and are subject to high temperature gradients, and eventually, to chafing.

In a previous work, we presented a reflectometry system aiming to monitor the health status of the power harness of a reusable launcher. A reflectometer is able to sense impedance variations in a propagation channel which can be due to several causes such as an intermittent fault in the harness causing a short/open circuit, soft defect due to harsh environmental conditions, but it can also be caused by normal changes within the system, for example during high current peaks.

The monitoring system should be as sensitive as possible, but with as few false alarms as possible. This study's goal is to ensure that the presence of batteries will not cause false alarms in the system especially during power consumption peaks. In a first part, we give details about the mission, and more specifically about the power harness. The use case is completed by the description of a representative battery pack suitable for such a mission.

Then, we construct the model of the representative battery pack, exploring the following parameters: the remaining energy and the instantaneous current. In order to build this model, we had to realize a dedicated measurement bench to extract the complex impedance of the battery when delivering a specific current. Then, in a third part, we inject the battery model in the model of harness, and simulate reflectometry measurements on it. The influence of current peaks is brought to light by comparing different simulations where the instantaneous current goes up, while other parameters are left unchanged. Finally, we conclude on the sensitivity of our harness monitoring systems in the presence of power consumption peaks.