

SPACE SYSTEMS SYMPOSIUM (D1)
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SPACE SYSTEMS SURVIVABILITY: A NEW APPROACH FOR THE DESIGN OF SPACE SYSTEMS

Abstract

From 2008, Onera, the French Aerospace Lab, has conducted inner studies on space systems vulnerability. A new paradigm was introduced to quantify the performances of a space system by considering its mission as a whole and not only the satellite(s). An innovative methodology to evaluate vulnerability over a space system's lifetime has been developed.

Even though a space system may be endangered several times during its designed lifetime, our interest here is to develop a methodology allowing the design of a space system which will continue to perform its mission at the same performance level. This is where we introduce notions of survivability. We propose a definition of survivability to quantify the capacity of a space system to continue operations, even while partially and/or temporarily damaged.

Using these vulnerability and survivability analyses as a basis, a new approach for space system design is being developed, using tools such as functional analysis, our 3R concept (Redundancy, Responsiveness and Reconfiguration), and fractionation.

To start our design methodology, we choose a space mission and a space system to fulfil it, and thus define baseline performances. We also choose one or several phenomena (space debris, acute space weather) that will affect the space system. A vulnerability analysis is then performed in order to identify how these phenomena impact the functions of our reference space system. Those results are inputs to define counteractive principles to improve the design of the space system by minimizing:

- the capacity of these phenomena to "reach" the system,
- the short and long-term impacts on the system's performances.

This paper describes the building blocks of this methodology and the steps taken into the 3S (Space Systems Survivability) project conducted at Onera for the ongoing development of these tools.