SPACE SYSTEMS SYMPOSIUM (D1)
System Engineering - Methods, Processes and Tools (2) (6)

Author: Ms. Ludivine Boche-Sauvan
Airbus Defence and Space, France, ludivine.boche.sauvan@laas.fr

Dr. Bertrand Cabon
Airbus Defence and Space, France, bertrand.cabon@astrium.eads.net
Dr. Marie-José Huguet
LAAS-CNRS, France, huguet@laas.fr
Dr. Emmanuel Hébrard
LAAS-CNRS, France, hebrard@laas.fr
Mr. Pierre Mignonat
Airbus Defence and Space, France, pierre.mignonat@astrium.eads.net
Mr. Simon Meredith
Airbus Defence and Space, France, simon.meredith@astrium.eads.net

TELECOMMUNICATION SATELLITE PAYLOAD TEST SEQUENCING OPTIMIZATION

Abstract

Over the past decades, telecommunication demand has led to satellites with an increasing number of channels, and as a consequence the complexity of any task associated to the payload design, test or performance validation has increased. Before being delivered to the telecommunication operator, the complete spacecraft must be tested to show its ability to survive the anticipated environment. The satellite must be tested under a simulated space environment under thermal vacuum created in a vacuum chamber. This phase is critical and expensive for the satellite manufacturer, who therefore aims at minimizing its duration. Performing a test requires the full payload, or a part of it, to be in a specific configuration. This configuration preparation may be time consuming. A sequencing tool is being upgraded to minimize the duration thanks to an adequate sequence optimization. Several tests have been performed with different algorithms, which have been developed for different sequencing strategies.

A first historical strategy aims at minimizing the number of payload reconfigurations. The overall satellite test sequence is then divided in series of tests grouped by payload configurations run sequentially. This strategy induces unproductive preparation times between the different test packages. A new strategy has thus been implemented to mask the preparation time. Considering all functional and thermal payload constraints, each test is prepared while previous tests are running. These last running tests must be compatible with the simultaneous test preparations.

The historical strategy version runs with a constraint programming algorithm. However, in the context of the new strategy, this algorithm does not scale well with the problem size, so a dedicated simulated annealing algorithm has been developed. The optimization targets the following objectives: minimize unmasked time preparation, but also enhance payload thermal stability, avoiding big operational thermal constraints evolutions which might demand added heating or cooling time.

An experimental study had been performed with 3 different satellite architectures, leading to several realistic test cases. These are derived from different thermal vacuum phases, different tests lists, and different preparation time requirements according to operational teams' requirements. The results are promising: the preparation times have been fully masked and the payload heating units are managed in order to keep a good thermal stability.

The next improvements will focus on improving the speed of the algorithm, and on its operational flexibility.