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ATTITUDE CONTROL FOR THE A5ME UPPER STAGE - FROM CHALLENGING REQUIREMENTS TO A FEASIBLE CONCEPT DESIGN

Abstract

The next version of the European Space Agency's Ariane 5, the Mid Life Evolution (ME), is aimed to be operational in 2017 with a payload to geostationary transfer orbit capability of 11,200kg (24,600lb), 16Developed by ESA with industry and manufactured by EADS Astrium, the ME, the fifth variant of the Ariane 5 since the Generic, will also provide a 20t to low-Earth orbit capability. The Ariane-5 ME (Midlife Evolution) launch system is basically an evolution of the qualified A5ECA launch system with a completely new upper stage.

The new upper stage features a cryogenic expander cycle engine capable of multiple re-gnitions (VINCI), providing additional performance and versatility capability, while the new upper part offers an increased payload volume.

The Attitude Control and Propellant Settling System (SCATE=Système de Contrôle d'Attitude et de Tassement des Ergols) for the A5ME upper stage is a subsystem, which fulfils a number of functions including distancing, attitude control and propellant settling and helps preparing the launcher for its de-orbitation. It is therefore more than "just" an attitude control system. The variety of functions and resulting thrust levels makes it necessary to install two different subsystems onboard the stage to fulfil the required tasks. The peculiarity of A5ME (in comparison to the standard Ariane 5 ECA launcher) is the "multi-mission approach" that characterizes the currently ongoing development phase. On top of the nominal GTO double payload mission, the future launcher shall be compatible with launches into GTO/GTO+ and LEO orbit, in addition to a lot of other secondary missions.

The different missions and the resulting need for versatility of the upper stage have a major impact on the SCATE system. Depending on the mission, there is a varying number of ignitions and re-ignitions, of coasting phases (also varying in duration) as well as different manoeuvres to be supported by SCATE.

The process to cascade a set of requirements, which enabled the decision for the final architecture of the SCATE subsystem was a major task. The paper deals exactly with these challenges and describes the process of deriving a final set of feasible requirements starting with the above-mentioned set of multi-mission requirements and explains how the final choice of the propulsion systems on board was made.