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A PRELIMINARY DESIGN OF A MISSION TO TRITON: A CONCURRENT ENGINEERING APPROACH

Abstract

The early stages of a space mission design are crucial for the development of the whole project because they strongly influence the ensuing design phases. Moreover, feasibility assessment at early stages brings to time and cost reductions and strongly determines the overall performances of proposed solutions. Concurrent Engineering (CE) is a systemic and systematic design strategy that employs real-time interdisciplinary activities for product development. The advantage of the CE approach is particularly noticeable in the study of systems of high complexity, as space exploration systems do. The aim of this work is to show how a Concurrent Design approach can be profitable in the development of a pre-phase A study of an interplanetary space mission, by means of a greater and effective exchange of information,

enlarging the solutions tradespace, highlighting system criticalities and solving inter-subsystem conflicts. The case study, TRIton Tomography Orbiter (TRITO), is conceived as a mission to investigate the Neptune system and its main moon Triton, which is of scientific interest due to its geological activity and the possible presence of subsurface oceans. The possibility of a pre-science phase in orbit around Neptune has been considered, giving the opportunity of precise measurements of its gravitational and magnetic field, together with its upper atmosphere composition. Therefore, a complex suite of instruments composed of magnetometers, laser altimeters, cameras and spectrometers, constitutes the payload and accomplishes the mission objectives. The spacecraft will fly a 15-year trajectory, including different flybys both in the internal and external Solar System, to Neptune system, ending with an aerocapture manoeuvre within the atmosphere of the icy giant. The highly challenging mission constraints encountered in the system development define the perfect environment for the application of a CE approach. The collaborative approach of CE is demonstrated to be very helpful not only in finding solutions meeting the strict constraints imposed by the harsh environmental conditions, but also for the individuation of the optimum solution related to mission analysis and mass budget aspects according to the system criticalities. A particular point where CE approach demonstrated to be a powerful approach is the choice to use of an aerocapture manoeuvre. Indeed, in the face of a large propellant mass saved an increasing in spacecraft design complexity must be accepted. The CE approach has been demonstrated to be an unavoidable design methodology for the development of systems showing a high-level of sub-systems interconnections and simultaneous interactions of different engineering domains.