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SPACE SYSTEMS SYMPOSIUM (D1)
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INTERPLANETARY CARGO TRANSFER VEHICLE BETWEEN EARTH AND MARS: MISSION ANALYSIS AND SYSTEM CONCEPT DEFINITION

Abstract

The human colonization of Mars and the exploitation of its resources represent two of the main challenges for the space sector in the far future. Such an important achievement will be possible only by establishing a complex infrastructure on the planet. A surface base, ascent/descent vehicles, power plants, ISRU facilities, and surface vehicles will be essential if a stable crew presence is to be established on Mars. However, the economic effort associated with the high number of launches required to build up such a complex architecture raises some serious concerns about the mission's feasibility. New concepts and transfer strategies are required to ease the access to the Martian orbit and reduce the costs associated with cyclical transfers of heavy cargo between Earth and Mars. The following article presents the mission analysis and architecture definition of an innovative system concept initially developed in the frame of the SEEDS VIII (SpacE Exploration and Development Systems) International post-graduate Master programme. The system has been named CRUISER (Cargo Reusable Interplanetary Standard Transporter). The paper is divided into three main sections. Firstly, it identifies the main mission challenges, such as rendezvous and docking manoeuvres far from Earth and in-orbit refuelling operations. The major constraints and design driving factors with which the transfer vehicle must comply are also presented. Secondly, the article describes the transfer orbit and the rationale behind the choice of departing from the second Sun-Earth Lagrangian point. Both functional analysis and concept of operations are then summarized and the overall architecture of the vehicle is illustrated, with particular focus on the Propulsion System and the Electrical Power System (EPS). Subsequently, the paper presents the results and conclusions of the study, providing a preliminary estimation of the maximum payload capability and transfer

time, together with the spacecraft's power and mass budgets. Final comments focus on the identification of enabling technologies for the mission and the advantages that the development of the CRUISER would bring, in terms of cost and reliability compared to large and expendable launching systems.