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MARS SAMPLE RETURN: ERO NAVIGATION AND GUIDANCE DURING THE INBOUND LEG

Abstract

Mars Sample Return is a joint collaborative project between ESA and NASA aimed at bringing to Earth several surface samples from the Red Planet. The mission is considered a major milestone to enable Mars human exploration, because it will allow scientists to better understand the characteristics of Mars and, based on this information, to design the infrastructure that will receive the first astronauts travelling to the Red Planet. ESA is currently assessing the Earth Return Orbiter (ERO), responsible for locating and capturing a container of Mars samples, collected and launched into Low Mars Orbit by previous missions, and ensuring their safe return to Earth.

In order to achieve these ambitious mission goals, a detailed navigation analysis and guidance strategies are required for two main reasons: firstly, to assure the entry capsule targets the Earth during the inbound leg taking into account all the possible dispersions and dynamics uncertainties in the interplanetary course. Secondly due to Planetary Protection requirements, since Mars Sample Return is the first ever mission classified "Category V restricted" because it will bring back to Earth samples from a potentially biological active planet like Mars. Therefore, after the release of the capsule, it must be ensured that the S/C will not reencounter the Earth for at least 100 years under any circumstance.

As Thales Alenia Space Italy subcontractor, DEIMOS has been in charge of the Mission Analysis activities for the MSR ERO mission, including the interplanetary navigation and guidance of this critical phase. In the proposed paper the navigation solution next to the guidance strategy to target the Earth during the return interplanetary arc is presented, paying special attention to the sequence of maneuvers that guarantee the correct release of capsule with the samples towards Earth, while no reencounter with Earth will take place for at least the following 100 years.