44th STUDENT CONFERENCE (E2)
Student Team Competition (3-YPVF.4)

Author: Ms. Shahrzad Hosseini
Delft University of Technology (TU Delft), The Netherlands

Mr. Thibaud Verschoor
Delft University of Technology (TU Delft), The Netherlands
Mr. Roger Caenen
Delft University of Technology (TU Delft), The Netherlands
Ms. Colleen Stevens
Delft University of Technology (TU Delft), The Netherlands
Mr. Laurens Kranendonk
Delft University of Technology (TU Delft), The Netherlands
Mr. Ramon Blanco Maceiras
Delft University of Technology (TU Delft), The Netherlands
Mr. Glenn Gezels
Delft University of Technology (TU Delft), Belgium
Ms. Parandis Fatemi Ghomi
Delft University of Technology (TU Delft), The Netherlands
Mr. Martin Georgiev
Delft University of Technology (TU Delft), The Netherlands

ADRESTIA - THE FIRST MANNED FLY-BY MISSION TO MARS

Abstract

Flying a manned spacecraft to Mars is a vision which is developing gradually and inspires to set a footprint on the Red Planet. Therefore, this mission focuses on the design of an end-to-end fly-by mission launched by 2018, while accommodating for two people.

The design process was initiated by the determination of optional trajectories and preliminary subsystem designs. After this phase, design options were analyzed and trade-offs led to the overall mission overview. Subsequently, the detailed design process began in which all mission specifications were thoroughly identified from launch through landing. This resulted in a spacecraft with a total mass of 15,580kg performing an optimized Earth-Departure Free-Return trajectory, with a total mission cost of US$5.85B.

The first step of the mission is the launch of a Falcon Heavy which will carry fuel to a Low Earth parking orbit. The second step is the launch of the SpaceX Dragon re-entry capsule with two extended trunks, which carry the crew and the living module on board of a SpaceX Falcon Heavy launcher. Next, on-orbit docking is performed and the refueling process, assisted by the crew with an Extravehicular Activity, takes place. Thereafter, the system undocks and the spacecraft is ready to start its interplanetary journey, initiated by a Trans-Mars trajectory injection.

Since this mission marks the very first manned mission towards Mars, the Environmental Control and Life Support System is of great importance. This advanced Physico-chemical system ensures the safety of the crew and sustains human life and workability. This opportunity allows for a number of scientific experiments to be brought on board, bringing to life the interplanetary mission experiments that have been performed in different projects on Earth.

Halfway the 501-day mission, the first manned Martian fly-by is performed with a duration of ten hours, approaching Mars to an altitude of 180km. Using Mars' gravity, the spacecraft obtains a velocity boost to continue its trajectory and journey back to Earth.

In the final stage, the spacecraft approaches Earth and the crew moves back to the Dragon capsule with an Extravehicular Activity. The living module will continue on its trajectory into a heliocentric orbit where it will be used to collect deep space environment measurements. The re-entry capsule is jettisoned and performs a direct re-entry. Finally, the crew is retrieved from the capsule and this inspirational and innovative mission is completed successfully.