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DESIGN OF HABITABLE MODULES FOR A MARS TRANSFER VEHICLE WITH A FOCUS ON REDUCTION OF MICROGRAVITY-RELATED PROBLEMS AND PROTECTION FROM THE SPACE ENVIRONMENT.

Abstract

After the return to the Moon, Mars is the next target for human exploration of the solar system. Regarding that, there is an increasing interest in exploring possible solutions for a safe journey from the Earth to this planet. The interplanetary transfer presents a technological challenge since the crew is exposed for several months to hazardous phenomena such as cosmic rays, solar flares and micrometeoroids. Moreover, the prolonged exposure to microgravity causes deconditioning on the astronauts' bodies, with a high probability of serious injuries and difficulties during the first stage of Mars surface operations.Possible solutions to these problems have been investigated as part of the project work for the XIV Space Exploration and Development Systems (SEEDS) Specializing Master's Programme, hosted by Politecnico di Torino, ISAE SUPAERO, University of Leicester with the collaboration of Thales Alenia Space, ALTRAN, ALTEC and endorsed by ASI and ESA. In this frame, a multicultural and interdisciplinary group of 45 students worked together to develop the concept of a Mars Transfer Vehicle. The exploration scenario is envisaged in the years after 2030, when orbital infrastructures such as the Lunar Orbital Platform-Gateway and the Orion spacecraft would be fully operative, considering the availability of launchers with high lifting capacity and the possibility of on-orbit assembly. With these assumptions, possible configurations of the habitable modules for a Mars Transfer Vehicle have been explored to protect the crew from the aggressive space environment, reducing the impact of the absence of gravity, and improving habitability. As a result, a trade study of the possible architectures is performed considering effectiveness, feasibility, and cost. A preliminary design is then proposed and critical technologies required are pointed out.