46th STUDENT CONFERENCE (E2)
Student Team Competition (3-GTS.4)

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PERMANENT CREWED MARS BASE BY 2030 - OUTCOMES OF AN INTERDISCIPLINARY, MULTINATIONAL STUDENT WORKSHOP

Abstract

Indisputably, we live at the dawn of a novel space exploration era, with the space sector undergoing significant changes. The International Space Station (ISS) is nearing the end of its lifespan and a competitive space industry is emerging, characterized by an ongoing redistribution of responsibilities between government agencies and private enterprise, with all stakeholders setting ambitious goals for future missions. Recently, interest in the next crewed space exploration mission has grown continuously. Driven by these developments, the Space Station Design Workshop (SSDW) 2017 in Stuttgart, Germany, posed the challenge to conduct the preliminary analysis and develop a viable proposal to establish a permanent space station in the vicinity of Mars by the year 2030. Two multinational, interdisciplinary teams of twenty students each were given one week to develop their own solutions and present them to experts from industry and academia. The authors, 'Team Blue', have outlined a design for a Mars surface station, called 'HUMANS2MARS'. This proposal requires the development of mission-specific modules, while the launchers to be used include the foreseen state-of-the-art at the late 2020s, such as the Space Launch System from NASA and Falcon Heavy from SpaceX. Planning such a mission from scratch in one week posed great challenges, either innate in the technical and programmatic difficulties of the mission, or resulting from the time constraints and group dynamics of the project. The main technical challenges can be grouped into two sets. The first includes those related to mass and payload limitations of the missions and launching costs. The second consists of those related to the human element of the mission. Due to the hostile Martian environment, extreme radiation levels during transit and unexplored psychological pressure on the crew, the complexities associated with humans introduce significant uncertainties. Potential solutions to the problems discovered have been proposed and are presented in this paper, within the framework of a multicultural and interdisciplinary workshop. The major risks of the proposed mission are identified and possible mitigation strategies and backup scenarios are discussed, thus providing a starting point for future research and detailed studies. The complexity of the mission and nature of the SSDW require addressing a great variety of challenges under severe time constraints. A crucial factor in the success of this effort has been the multidisciplinary and diverse academic background of the participants. This enabled the team to overcome these numerous obstacles in often unconventional ways.