Human Exploration of the Moon: Protection Solution Against Dust

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ABSTRACT

International space exploration plans and scenarios are driven by the long-term goal to enable human exploration of the Moon and Mars. To prepare for these ambitious undertakings, robotic and human space missions are required to gradually develop and demonstrate the enabling technologies and capabilities. A collaboration between the Piedmont Aerospace District and the Piedmont regional government started a research programme, STEPS, to develop the suitable technologies necessary for the future exploration missions of the solar system. In relation with a project of a manned rover for the exploration of the lunar surface near the south pole, the purpose of this work is to demonstrate the feasibility of a dust removal system as part of the Life Support System of the rover. In fact the pervasive presence of lunar dust could jeopardise the return of humans to the lunar surface. The filtration device consists of three stages. A cyclonic separator has been selected as a first stage, due to its design and realization simplicity within a maintenance free condition. The second stage will be a thermophoretic separator able to filtrate smaller particles in order to preserve the Ultra Low Particulate Air (ULPA) filters of the last stage. ULPA filters have been chosen to filter the ultrafine dust fraction. JSC-1A has been selected as lunar simulant to test the final prototype. In particular, JSC-1A has been modified in order to better match the actual lunar dust behaviour. The work has continued with the preliminary drawing and design of the cyclonic system, using the parameters deriving from the requirements of the whole project and dust properties. This phase has been necessary to carry out the following phase: the fluid dynamic simulation of the bi-phasic flow. The commercial software Star-CCM+ is used to simulate the cyclone performances and to improve its initial design. The present report aims to describe the work performed during the first year of the STEPS program, presenting the obtained data, and introducing the on-going activities.