Integrated EVA Thermal Simulations using TherMoS and V-SUIT

Abstract:

Two dynamic simulation tools have been developed at the Technical University of Munich in the past years: The Thermal Moon Simulator (TherMoS) and the dynamic portable life support system (PLSS) simulation Virtual Space Suit (V-SUIT). Development of TherMoS and V-SUIT started in 2009 and 2011, respectively. Both tools are MATLAB®-based and spinoffs from the Virtual Habitat (V-HAB) project. V-SUIT aims to dynamically simulate space suit portable life support systems and both their interaction with a detailed and dynamic human model, as well as the dynamic external environment of a space suit moving on a planetary surface. TherMoS was initially developed to enable the dynamic thermal simulation of moving objects on the lunar surface in general. To achieve this, a thermal model of the lunar surface is created including three-dimensional features like craters and boulders. For the use with V-SUIT, TherMoS provides information about heat transfer between the space suit and its environment. This paper describes the process of connecting V-SUIT and TherMoS to each other. Interfaces between both simulation tools allow TherMoS to transfer information about radiation exchange factors and boundary nodes to V-SUIT. In turn, V-SUIT performs the overall thermal calculations in combination with the PLSS simulation. Once all interfaces were established, a model of a generic spacesuit was created and run through several dynamic simulation scenarios. The thermal calculations for the radiative heat transfer performed by TherMoS were validated against results from ESATAN-TMS thermal modeling software using a correlated model. Results show the effects of the dynamic thermal
environment propagating through the different layers of the models, from the suit exterior via the suit layers to the inside where the interactions with the suit gas flow and the astronaut are modeled.

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