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CHARACTERIZATION OF THE METHODS TO ACHIEVE A HIGH QUALITY ON THE RAPID PROTOTYPING OF 3D PRINTED SPACE SUITS: CASE OF STUDY NDX3 SPACE SUIT.

Abstract

The popularization of rapid prototyping solutions as an answer for different challenges in the future of space exploration has motivated Human Spaceflight Laboratory at the University of North Dakota to start the design of a new generation of planetary space suits based on 3D printing. The first concept demonstrator of a flexible 3D printed space suit, named the NDX-3, uses thermoplastic polyurethane (TPU), a flexible material suited for this type of manufacturing. This space suit would allow future astronauts to repair and build space suits without depending on the delivery of parts from the Earth.

During the development of the first prototype of the NDX-3,the authors noticed the differences between the quality of some manufactured 3D printed parts, mainly due to the complex geometry of some sections. This affected some of the requirements that 3D printed space suits will require, such as mobility, resistance to tension and pressurization. During the manufacture and testing it is observed that most of these differences are due to the specific geometry of the specific part, the settings of the 3D printer, the quality and formulation of the filament, and the environmental conditions during the printing. This paper analyzes all the variables which affect the quality of the printing in order to improve the performance and reliability of the following versions of the NDX-3.

To determine the quality of the TPU, parts of the space suit are printed with different designs and settings to compare the surface quality, microscopic structure, and the performance during pressurization tests.

This research seeks to explore the recommended methods and settings necessary to achieve the required quality during manufacture, as well as design strategies to avoid certain complex geometries that could be problematic during the manufacturing process.