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DESIGN AND 3D-PRINTING OF A MARTIAN SPACESUIT

Abstract

The future Martian spacesuits need to be extremely reliable and resistant, while allowing for local repairs and even manufacturing. This major challenge is more newsworthy than ever and needs to be resolved before considering a manned mission to Mars.

For two years, our seven-student group designs and builds an innovative prototype of a functional extravehicular Martian spacesuit by using 3D-printing. Most university projects on the topic concern analog spacesuits for simulation purposes, whereas our prototype aims at being pressurized, refrigerated and equipped with all the systems necessary for a real mission (breathing apparatus, automatized temperature management, on-board computer. . .).

Our goal is to make a spacesuit that really allows a marsonaut to survive for thirty minutes on the Red Planet, providing the tools and capacities needed for a human exploration mission.

After a vast review of both past and present-day state-of-the-art spacesuits, we have devised the prototype of a semi-rigid spacesuit. It relies on a 3D-printed rigid back-pack which covers the trunk and head of the marsonaut, while the limbs are protected by multiple layers of complementary material including Kevlar, nylon and urethan. The rear of this back-pack can be opened like a door for easy access, while the spacesuit can be stored outside the Martian module with an adapted airlock. This feature allows for more space inside the module, limits the entry of abrasive dust and significantly reduces the human contamination of the Martian environment.

The use of 3D-printing constitutes a major innovation as it permits the repair and even fabrication or recycling of spacesuits on location. Multiple traction tests and numeric simulations have proven to us that the ABS plastic used by usual 3D-printers will resist the very low Martian pressure. A thermodynamic study has also showed that the inside pressure and temperature will be adapted for human activities. This winter, extensive testing in the desert of Utah allowed us to demonstrate that our prototype gives sufficient mobility to the marsonaut for efficient field exploration (samples picking, drone controlling, rover driving. . .).

The structure of our prototype is completely modular, which allows for simplified maintenance. In addition, we have chosen simple and proven technologies for critical elements such as the breathing apparatus. The final prototype weights 55 kilos, the equivalent of 20 kilos on Mars.

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