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APPLYING 3D PRINTING TO RAPID PROTOTYPING OF SPACE EXPERIMENT PAYLOADS

Abstract

This paper presents a feasibility study about designing and prototyping an experiment for the NanoRacks platform, using commercial, consumer-grade 3D printing technology. The NanoRacks system is a relatively cheap commercial experiment platform aboard the ISS open to everyone. Experiments are configured to fit inside the typical cubesat “one unit”, or “1U” (10x10x10 cm), dimensions.

The recent emergence of affordable 3D printing technology might offer a fast and cost-efficient means to “print” NanoRacks experiments as rapid prototypes and submit them to extensive ground testing afterwards, thus helping to reduce the risk of subsequent technical failure in flight.

The prospect of having a powerful and cost-efficient tool for experiment designers, especially in education, inspired a feasibility study at the International Space University (ISU) in Strasbourg, France. This study put special emphasis on assessing whether current, non-modified 3D printers and materials can meet the requirements applying to “space-qualified” hardware for ISS experiments.

In order to enable proper analysis and testing, a functional prototype for a protein crystallization facility was designed and built during the course of a student project at ISU. Prototype manufacturing took place on a consumer-grade 3D printer with a purchase price of roughly \$2500. The completed prototype has been tested against official guidelines for ISS experiments, making extensive use of NASA material databases.