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CONCEPTUAL DESIGN FOR A 3D PRINTER USING MOON REGOLITH AND SOLAR ENERGY

Abstract

Human exploration in space is at its dawn, with the Moon being considered as the very first step towards deep space exploration. Establishing a lunar base is perceived by many as a crucial milestone in this endeavor, and in-situ resource utilization will be pivotal in order to create such a settlement. Additive manufacturing (AM) has emerged as a vital mean by which to manufacture hardware on the Moon, enabling the construction of a lunar settlement to be independent from Earth's resources and therefore rendering it economically feasible.

This work presents a conceptual design for a 3D printer prototype utilizing Moon regolith to manufacture hardware, employing the Sun as the power source. The proposed concept extends the current working principles of conventional 3D printing in order to achieve a technology adapted to lunar conditions. In this design, a Fresnel lens concentrates solar beams and projects them to a fixed fusion point on the printer bed. This is mounted on a support structure enabling the sintering area to translate with three degrees of freedom. The axes of the support structure are mounted on rails and straps, powered by three motors located on each axis, activate their respective motion.

The printing material, lunar regolith powder, is supplied by a feeder system, which employs gravity to propel the regolith to the sintering area. It is spread and compressed by a prism, and guided by two rails attached at both ends of the printing area. Finally, a strapping system linking the feeder system to the "z" axis motor will ensure the proper deposition of each regolith layer and the precise functioning of the layer-by-layer printing process.

This innovative 3D printer would greatly accelerate the return of man to the Moon in a permanent manner by providing a novel technology to create a lunar settlement, using the most abundant resource available, lunar regolith.