Design and Development of an Autonomous Sandbag-Filling Lunar Robot

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The next step in space exploration is the development of a sustainable cis-lunar economy and, eventually, building lunar bases to support it. NASA Artemis and other international efforts are paving the way for it. Constructing infrastructure such as blast walls, shelters, and storage is the first step in establishing the lunar base. Current proposed methods for lunar infrastructure construction, such as 3D printing and molding, often involve significant energy consumption and complex machinery, resulting in high costs. While 3D printing is well-established on Earth, its effectiveness in the low-gravity lunar environment remains to be fully explored. Given the complexity and cost, there is a need for straightforward and cost-effective methods to build lunar infrastructure using ISRU materials on the Moon. We propose a sandbag as a building block for constructing the lunar structures. The lunar environment poses unique challenges for astronauts, including extreme temperatures and abrasive lunar dust. Robots offer a viable solution capable of operating in these harsh conditions without the same safety constraints as humans. Robots can perform complex and repetitive tasks in an efficient, timely manner, allowing for a significant reduction in human labor efforts and an increase in productivity. As automated robotic systems perform more strenuous labor, humans can tend towards exploration tasks and further lunar research. This work involves designing and developing an autonomous robot filling and bagging sandbags on the lunar surface. We explored and compared various sandbag-filling robots that could be modified and used for lunar construction. Further, we developed a small-scale prototype to test its efficiency of filling and bagging.