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# STEPS TOWARD SELF-ASSEMBLY OF LUNAR STRUCTURES FROM MODULES OF 3D-PRINTED IN-SITU RESOURCES

**Abstract**

This paper explores the idea of 3D printing entire self-assembling robots – structure, actuators, sensors and electronics – from lunar-derivable material. Such a capability would effectively bootstrap the construction of lunar bases and other facilities from the Moon itself with the launch of minimal material from Earth. Self-assembly has long been viewed as a highly desirable capability for autonomous construction of large space and planetary structures. There are two approaches: (i) the adoption of homogeneous modular building blocks that can be constructed in large numbers and can configure themselves into an array of different configurations – the cellular approach – including self-replicating blocks; (ii) a more practical approach that defines a small set of heterogeneous modules that can act as building blocks for constructing more functionally diverse structures such as lunar bases. We have focussed on the latter but the technology presented could be readily adapted to the former. In particular, the common features of all self-assembling modules are that the modules constitute a structure housing a computer-controlled actuator internally and a reversible latching mechanism externally. We have made significant successful steps towards self-assembling systems in which the modules can be manufactured from in-situ resources. We have demonstrated a 3D printed DC electric motor in which the only components that were not 3D printed are the wire coils. We are however working on the wiring aspect and shall present the challenges in achieving this while restricting ourselves to lunar analogue technologies. Indeed, this aspect is crucial to realising the next stage of implementing 3D printed computing electronics. We have married our 3D printed motor prototype to a 3D printed trigon-type panel developed as part of the trigon self-assembling system concept. The trigon concept underlies a modular approach to self-assembling planetary structures such as bases, etc. The 3D printed motorized panel system demonstrates that the motor aspect and structural aspects of robotic self-assembling machines are amenable to 3D printing. Furthermore, motorised self-assembling systems can be leveraged from local resources.