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Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies (2B)

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THE "SENSIBLE" WAY TO CONSTRUCT ROBOTS FROM LUNAR RESOURCES

Abstract

It is highly desirable to exploit in-situ lunar resources for more sophisticated products than structure (such as regolith and/or metals like aluminium) and volatile consumables (such as water). Although in-situ bulk materials reduce the cost of lunar exploration dramatically, true sustainability requires lunar self-sufficiency through enhanced in-situ resource utilisation. Indeed, sustainability of a Moon Village will require the ability to maintain and grow itself. We submit that such enhanced capability should encompass the construction of robotic machines. In this way, the machines of production required to construct lunar infrastructure may be leveraged from the lunar environment itself. We explore how one specific aspect of robotics – sensors – may be constructed from lunar resources. We focus on two families of sensor – displacement sensors and their derivatives as the most fundamental of measurements and light sensors for general measurement-at-a-distance. We emphasise that terrestrial approaches may not be appropriate to accommodate the constraints imposed by the Moon and our projected manufacturing capabilities. Potentiometers of aluminium extracted from anorthite offer access to displacement sensing and strain sensing. Piezoelectric sensors may be constructed from quartz manufactured from silica extracted from anorthite. Elastomeric silicone plastic derived from lunar volatile condensates offer the potential for tactility. Light sensors may be constructed from photomultiplier tubes, all components of which can be derived from lunar material. Photomultiplier tube resolution is limited but small arrays may be employed – there is little prospect for imaging camera arrays. However, optic flow offers the visual capabilities of insects using simple circuitry. Alternatively, active vision allows us to trade the deficiencies of the vision sensor with the capabilities of the orienting motor. This offers more sophisticated capabilities through visual micro-stepping. We also explore the possibility of simple analytical instrumentation constructed from lunar resources. We suggest that an array of sensors with actuators can be constructed in-situ from lunar resources – sensors and actuators are fundamental components of robotic machines essential for a sustainable extraterrestrial infrastructure.