20th IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Interactive Presentations (IP)

Author: Prof.Dr. Pierfrancesco La Mura
Germany

THREE TYPES OF ROBOT BUILDER FOR THE UNSUPERVISED CONSTRUCTION OF MARS HABITATS

Abstract

We describe three robot designs suitable for the unsupervised construction of habitable structures on Mars using locally sourced materials, and discuss the relative advantages and disadvantages associated to each of those designs. The first and most basic type of autonomous robot builder, ARBie, is a stone gatherer. Characterized by very modest energy requirements, ARBie can build modular, cone-shaped structures in dry masonry style out of gathered stones, gravel and clay material collected on location. The second type of robot builder, B-ARBie, is a brick-maker. Equipped with a static press, B-ARBie collects, filters and mixes locally sourced clay and gravel material, then vibro-presses it to produce dry bricks with interlocking profile. With moderate energy requirements, B-ARBie proceeds to build modular, vaulted structures with square or rectangular base. The third type, C-ARBie, is a stone-cutter. Equipped with a stone-cutting tool, C-ARBie has higher energy requirements relative to ARBie or B-ARBie, but can build massive vaulted structures with a variety of large, precisely shaped elements. The three robot builders share the same basic body plan: a six-legged frame with on-board PV cells and control electronics, actuated by compressed CO_2 harvested from the Martian atmosphere and stored in liquid form as a rechargeable power source. As a power storage medium liquefied CO_2 has energy density comparable to lead-acid batteries, but contrary to the latter can be cycled indefinitely, and is able to operate at Martian temperatures. An important advantage shared by the three robot designs is that their functionality and productivity can be easily tested and optimized on Earth. Over the course of its operational lifetime a small team of autonomous robot builders would have the potential to build a vast grid of interconnected, modular habitats out of locally sourced materials with no further need for external provisions or support.