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Mars Exploration – Science, Instruments and Technologies (3B)

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ROBOTIC ARMS FOR MARS SAMPLE RETRIEVAL

Abstract

A lightweight and dexterous robotic arm applicability to Mars sample retrieval has been studied. At the same time the robotic arm is lightweight and reduced in envelope size, Highly capable in terms of mobility (e.g. fast) and highly reliable, since its goals (e.g. the retrieval of cached samples) are critical elements of a Mars Sample return mission. The considered robotic arm architecture consists of a 6 d.o.f. arm, with 6 joints and two limbs. The wrist is spherical. The longer link (0.6 m long) is the one closer to the arm base, whereas the other link (0.5 m long) is the one closer to the end effector. Each joint has a travel capability of 320. The total mass of the system is 4.5 kg, with a payload capacity of 2.5 kg. Power budget is in the 10W range (including 20In addition to the robotic system itself, appropriate Hold-Down and Release Mechanisms (HDRM) will be needed for the launch phase. The simplest end effector is a one degrees-of-freedom solution and consists of a gripper with 3-fingers. An alternative and more versatile solution implements a 4-finger axial-symmetric layout. Preliminary mass budget estimation for the Gripper is 0.4 Kg. Power consumption is in the order of 5-7 W. The study was done on the capability to retrieve cached samples: as soon as the rover assumes a position where a cached sample is present within the 'operative work space' of the robotic arm, localized by the stereo-cameras of the rover itself, this information is passed to the control algorithm of the arm in order to determine the Cartesian motion that the arm shall perform to achieve the target. With this information, the gripper has been conceived so that no additional cameras/sensors are necessary to be able to grasp the cached sample. Solutions for temporary storage of the cached samples are presented as well.