SYMPOSIUM ON STEPPING STONES TO THE FUTURE: STRATEGIES, ARCHITECTURES, CONCEPTS AND TECHNOLOGIES (D3)
Novel Concepts and Technologies for the Exploration and Utilization of Space (2)

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DEXARM ENGINEERING MODEL DESIGN, DEVELOPMENT AND TESTING

Abstract

The goal of the DEXARM project is the development of a robot arm comparable in size, force and dexterity to a human arm, to be used for space robotics applications in which the manipulation/intervention tasks were originally conceived for humans. These applications are typically external or internal servicing of orbiting platforms or robotics for planetary exploration.

The main challenges of this development lay in the minimisation of resources that the applications require. To achieve this goal, ESA has encouraged the exploitation of innovative approaches and technologies to drastically minimise mass, volume and power consumption while providing adequate performance (output torque capability and positioning accuracy/repeatability).

The DEXARM project has been divided into three phases: • Phase 1: DEXARM definition This phase included system requirement definition, system architectural design and specification of requirements for sub-systems, preliminary design of joint (evaluating different architectures); • Phase 2: Joint development In this phase the detailed design, development, manufacturing and test of one joint prototype, including the relevant electronics, was performed; • Phase 3: DEXARM development After an iteration of the basic joint design based on prototype test results from phase 2, phase 3 included the development and manufacturing of joints, limbs and structures, assembly and integration in a dextrous robot arm system testbed and validation by system-level testing and demonstration.

The Engineering Model developed is a lightweight arm where the electronics to control the joints is embedded in the arm itself. Only a power line and a data bus interface the arm to the central controller. The arm main characteristics are: - 7 degrees of freedom (redundant kinematics); - Length and mass: 1.2 m, 25kg; - Power consumption: about 100 W; - Force-torque capability of 200 N and 20 Nm at the arm tip; - Payload handling capability of 10 kg at 1-g; - 1-g compatibility (without any special off-loading device);

The paper will describe the main design issues and systems tests results.