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DEVELOPMENT OF AN ULTRA-LIGHT ROBOTIC ARM FOR MARS EXPLORATION

**Abstract**

Robotic Arm is a key component of the mobile and manipulator subsystem of Mars rover, which requires a high level of integration and an intercross research involving mechanics, electricity, thermology, control, etc. The main function of the robotic arm is to fulfill scientific tasks by carrying the performance unit or the detector to the target position.

Different from the normal space environment, the complicated environment of Mars (low temperature, gravity, dust, etc.) makes higher demands upon the reliability and security of the robotic arm. Meanwhile, stricter requirements on the characteristics of the robotic arm, such as degree of freedom (DOF), weight, work space, precision, lifespan and drive torque, should be taken account of to meet the demand of load mass and different operation modes. Within these requirements, some specifications restrict each other, such as DOF and torque vs. weight, precision vs. reliability, etc.

In response to these requirements, Beijing Institute of Control Engineering developed an ultra-light 5 DOF robotic arm driven by five ultrasonic motors. This arm features:

- The use of composite materials and optimized structures for low weight and high intension(total mass: <5kg, total length: >1m);
- A high torque/weight ratio, high precision drive assembly and light angular sensors(load mass: >3kg);
- Thermal control and rotary seal against Mars dust;
- High performance servo drive technology.

The design, simulation, and development process are described in this paper.