

44th STUDENT CONFERENCE (E2)
Student Team Competition (3-YPVF.4)

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DESIGN, MODELING AND CONTROL OF A 6 DEGREES OF FREEDOM ROBOTIC ARM WITH
SPECIFIC APPLICATION IN PLANETARY EXPLORATION MISSIONS**Abstract**

This work presents the design, modeling and control of the robotic arm made for the planetary rover prototype being developed by students of IIT Bombay for participating in the University Rover Challenge-2014. The robotic arm is designed to accomplish various challenging tasks such as collecting soil-sample, connecting pipes into fittings, turning valves, screwing on connections, pushing buttons, reading pressure gauges and delivering packages. The arm is a 6 Degrees of freedom (DoF) closed loop system with 3 DoF for positioning of wrist and 3 DoF for orientation of the end-effector. Considering the weight restrictions and complexity of tasks, the arm is designed to be dexterous with a high payload to weight ratio, achieved by using various electromechanical actuators. This design has been validated using finite element analysis by ensuring that the stress concentrations, factor of safety and deformation are within safe limits. Based on the above mentioned tasks it was decided to have two different end effectors viz. a soil-digger and a gripper that is able to pick and place objects of width/diameter less than 110mm. In addition the gripper consists of an elastic roller belt mechanism around its fingers to accomplish the task of connecting pipes into fittings. In addition the gripper is able to grasp objects of any arbitrary shape. The controller of the arm is being designed based on the dynamic model. The fact that the positioning and orientation are decoupled is exploited to develop independent control blocks for each. The positioning of the arm is achieved by using an inverse kinematic algorithm and a forward kinematic algorithm is used for error correction. The arm wrist can be moved in different coordinate systems based on the requirement of task. The control algorithm will be tested on the fabricated robotic arm and the results will be presented at the conference.