

BEATRICE: A Low-Cost Manipulator Arm for an Educational Planetary Rover

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Abstract : The BEar Articulated TeleRobotic Inspection and ClaspIng Extremity is a lightweight, 5 DoF robotic manipulator for the Berlin Educational Assistant Rover (BEAR). BEAR is one of the educational planetary rovers developed under the Space Rover projects at the Chair of Space Technology of the Technische Universität Berlin. The projects serve to conduct research and train engineers by developing rovers for competitions like the European Rover Challenge and the DLR SpaceBot Cup. BEATRICE is the result of a cost-driven design process to deliver a simple but capable platform for a variety of competition tasks: object grasping and manipulation, inspection, instrument welding and more. The manipulator's simple mechatronic design, based on a combination of servomotors and stepper motors with planetary gearboxes, also makes it a practical tool for developing embedded control systems. The platform's initial implementation relies on tele-operated control but is fully instrumented for future autonomous functionality. This paper describes BEATRICE's development from its preliminary link model to its structural and mechatronic design, embedded control and AI and T. In parallel, it examines the influence of budget constraints and high personnel turnover commonly associated with student teams on the manipulator's design. Finally, it comments on the utility of robot design projects for educating future engineers.

Keywords : education, low-cost, manipulator, robotics, rover

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