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SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 2 (3B)

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USING FORCE SENSORS ABOVE PLANETARY ROVER WHEELS TO IMPROVE TRACTION CONTROL AND SOIL PARAMETER ESTIMATION

Abstract

An estimate of the normal force exerted on the rover by the underlying soil is critical to both traction control and soil parameter estimation on a planetary rover. Current methods of estimating this normal force include quasi-static force balance analysis, and measurement of the wheel-soil contact angle using tactile wheels or visual techniques. By using a linear bearing to reject off-axis loading, single-axis load cells were utilized on the Canadian Space Agency's Kapvik micro-rover to sense the component of normal force perpendicular to the ground when level. Traction control and soil estimation simulations on rough terrain are presented in which the measurement from the load cell is used to accurately estimate the normal force. An Unscented Kalman Filter, which includes measurements from typical planetary rover sensors, is used for state estimation. A comparison of the performance of a traction control algorithm with that of a conventional PID velocity control system is shown. The ability to accurately estimate the internal friction angle and cohesion of the soil is evaluated and compared with previous work. Preliminary experimental data are presented using the Kapvik rocker-bogie rover as a test platform.