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

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REAL-TIME WHEEL SLIPPAGE ESTIMATION FOR AN EXPERIMENTAL MARS ROVER

Abstract

Total distance travelled is one of the major performance metrics for a planetary rover. Unlike the pioneer Sojourner rover, which travelled approximately 100 metres in total, the new generation planetary rovers are tasked to cover much larger distances without getting stuck. They travel over many different types of terrain surfaces, including soft soil. A rover can get trapped if its wheels subjected to excessive slippage and sinks into soft ground. Modelling wheel-terrain interaction is a difficult task as a-priori knowledge of terrain information is limited. Thus, the rover can benefit from a real-time wheel slippage estimation system.

At the Australian Centre for Field Robotics (ACFR) we have developed a six wheeled Experimental Mars Rover (EMR). This rover has been commissioned as a part of the government funded "Pathways to Space" project and being operated in the Mars Yard of the Powerhouse Museum. The Mars Yard terrain has been carefully created to be as "Mars-like" as possible using materials closely resembling those actually found on Mars.

The EMR is equipped with a rich set of multi-modal sensors, including IMU and wheel encoders. In this paper we present a real-time wheel slippage estimation method for the EMR platform. This method is based on comparison of fused inertial sensor and wheel encoder data with a vision based egomotion estimation obtained from a monocular ground-facing camera. The Fourier-Mellin Transform and Phase-Only Matched Filtering techniques have been used in the egomotion estimation. The real-time wheel estimation software runs onboard the EMR and interacts with the motion control and autonomous navigation subsystems.