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AUTOMATED WHEEL SLIP DETECTION THROUGH CROSS-CORRELATION OF WHEEL ROTATION RATE, MOTOR CURRENT AND WHEEL FORCE SENSORS

Abstract

Rovers play a critical role in extraterrestrial exploration and are at constant risk of becoming stuck. The ability to identify wheel slippage is crucial in determining whether a rover can safely cross unknown terrain. The faster and more accurately a rover can identify the onset of slippage, the quicker it can adapt its planned route and reduce the risk of becoming stuck. This paper studies the cross-correlation of commonly available rover sensor data: motor current, forces, and rotational rates, combined with body-frame accelerometer data, all at a 40 Hz sample frequency. The proposed method collects the proprioceptive sensor data and analyzes it to determine if a wheel is slipping with less than 30 data points. The technique described in this paper also does not require prior knowledge of the terrain. Experimental results using a test vehicle driving over multiple terrain conditions demonstrate the method's effectiveness. We present three signal pairings from our experimental data sets that show the most substantial evidence of identifying wheel slippage in a rover.