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THE IMPACT OF SLIP AND ROVER MOBILITY IMPLEMENTATION CONSTRAINTS ON PLANETARY ROVER PATH PLANNING

Abstract

This paper describes a novel approach to rover mobility operations, to handle uncertainties like wheel slip and limited terrain knowledge of landing site. For planetary exploration rovers, one of the biggest challenges is mobility on an uneven, rocky terrain. Also, wheel - soil interaction causes the rover to slip and sink even on terrains with benign slopes. Given the coarse knowledge of the terrain and limited information on the soil characteristics at landing site an iterative path planning scheme has been developed. The aim is to minimize the risk of rover toppling by ensuring sufficient clearance from obstacles and avoiding steep slope terrains. The prime objective of path planning is to generate a safe path for the rover to traverse from source to destination. This is achieved by ensuring that the rover attitude does exceed the permissible value of roll and pitch angle. In this particular study, inverse kinematic model for 6-wheel rocker bogie mechanism has been used to determine rover attitude i.e roll and pitch angle, while traversing undulating terrain. During mobility, the rover deviates from its intended path due to slippage. Hence along with maximum permissible angles, a safe corridor of predefined width is taken as an additional input for path planning. The width of the corridor is dictated by the confidence on knowledge of slip in that area. The model assesses path deviations due to slip and different mobility commanding schemes. Multiple simulations are carried out for varying slip given the uncertainty in slip knowledge. A comparative study of the characteristics of multiple paths is carried out and based on the outcome, priority is assigned to each path. The path characterization is based on the following parameters - clearance from obstacle, path length, solar panel illumination status which decides power generation and whether path traverses any shadow region and if so, what is the duration of shadow. Thus, this method ensures safety in terms of power availability in addition to rover stability.