IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

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PATH PLANNING OF PLANETARY EXPLORATION ROVER TAKING INTO ACCOUNT SLIP AND MOBILITY OPERATION CONSTRAINTS

Abstract

For planetary exploration rovers, one of the biggest challenges is mobility on an uneven, rocky terrain. Additionally, wheel - soil interaction causes the rover to slip and sink even on benign slopes. Given the coarse knowledge of the terrain and limited information on the soil characteristics at landing site, replicating the terrain at testing facility has its own limitations. This paper describes a typical approach to rover mobility operations, during mission, taking into account uncertainties like slip and mobility operation constraints. Despite exhaustive testing on test bed, the slip experienced by rover while traversing on actual terrain may be different from that observed on test bed. Hence during mission, when path planning is carried out, this uncertainty should be taken into account. The 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 doesn't exceed the permissible value. During mobility, the rover will deviate from its intended path due to slippage. Hence along with source, destination, a safe corridor of pre-defined width is also taken as an input for path planning. During actual mission, if a large difference is observed between actual slip and slip value derived from testing, the width of the corridor will be changed to take care of the additional slip. The path generated will be such that, as long as the rover is within the bounds of the corridor it will be stable. Another concern for rover mobility operation is the nature of wheel speed commanding. A path is sub divided into smaller segments. Nominally for each segment either fixed wheel speed will be commanded or the path can be commanded in profile based mode in case with fixed wheel commanding there is large dispersion from intended path. Fixed wheel speed commanding is desired due to less complexity of implementation but the tradeoff is path dispersion. Hence a safe corridor width will be computed and commanded, to account for path deviation due to wheel speed commanding scheme. Thus there is a need to generate multiple paths from source to destination ensuring safe traversibility. Presently this study is being carried out on lunar soil stimulant test bed.