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Abstract

Here we develop and demonstrate a three-step strategy for finding a safe landing ellipse for a legged spacecraft on a small body such as an asteroid or planetary satellite. The first step, acquisition of a high-resolution terrain model of a candidate landing region, is simulated using existing statistics on block abundances measured at Phobos, Eros, and Itokawa. The synthetic terrain model is generated by randomly placing hemispheric shaped blocks with the empirically determined size-frequency distribution. The resulting terrain is much rockier than typical lunar or martian landing sites. The second step, locating a landing ellipse with minimal hazards, is demonstrated for an assumed approach to landing that uses Autonomous Landing and Hazard Avoidance Technology. The final step, determination of the probability distribution for orientation of the landed spacecraft, is demonstrated for cases of differing regional slope. The strategy described here is both a prototype for finding a landing site during a flight mission and provides tools for evaluating the design of small-body landers. We show that for bodies with Eros-like block distributions, there may be >99% probability of landing stably at a low tilt without blocks impinging on spacecraft structures so as to pose a survival hazard.

1. Introduction

Landed missions represent a vital stage of spacecraft exploration of planetary bodies. The access to surface materials provided by landing enables a wide variety of