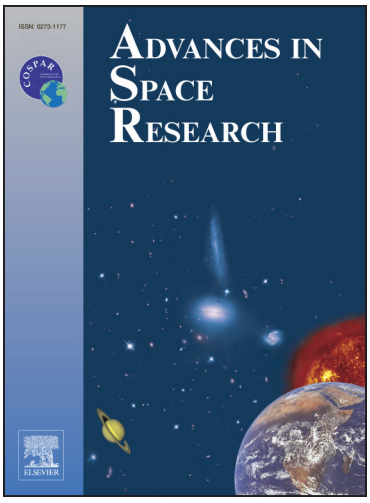

A Drilling Tool Design and In Situ Identification of Planetary Regolith Mechanical Parameters

Weiwei Zhang, Shengyuan Jiang, Jie Ji, Dewei Tang

PII: S0273-1177(18)30124-8
DOI: https://doi.org/10.1016/j.asr.2018.02.009
Reference: JASR 13627

To appear in: *Advances in Space Research*

Received Date: 1 November 2017
Revised Date: 31 December 2017
Accepted Date: 11 February 2018

Please cite this article as: Zhang, W., Jiang, S., Ji, J., Tang, D., A Drilling Tool Design and In Situ Identification of Planetary Regolith Mechanical Parameters, *Advances in Space Research* (2018), doi: https://doi.org/10.1016/j.asr.2018.02.009

A Drilling Tool Design and In Situ Identification of Planetary Regolith Mechanical Parameters

Weiwei Zhang, Shengyuan Jiang*, Jie Ji, Dewei Tang

State Key Laboratory of Robotics and System, Harbin Institute of Technology, Harbin 150001, China

Abstract: The physical and mechanical properties as well as the heat flux of regolith are critical evidence in the study of planetary origin and evolution. Moreover, the mechanical properties of planetary regolith have great value for guiding future human planetary activities. For planetary subsurface exploration, an inchworm boring robot (IBR) has been proposed to penetrate the regolith, and the mechanical properties of the regolith are expected to be simultaneously investigated during the penetration process using the drilling tool on the IBR. This paper provides a preliminary study of an in situ method for measuring planetary regolith mechanical parameters using a drilling tool on a test bed. A conical-screw drilling tool was designed, and its drilling load characteristics were experimentally analyzed. Based on the drilling tool-regolith interaction model, two identification methods for determining the planetary regolith bearing and shearing parameters are proposed. The bearing and shearing parameters of lunar regolith simulant were successfully determined according to the pressure-sinkage tests and shear tests conducted on the test bed. The effects of the operating parameters on the identification results were also analyzed. The results indicate a feasible scheme for future planetary subsurface exploration.

Keywords: planetary regolith; mechanical parameters; in situ identification; drilling tool

1 Introduction

Studies focusing on measuring geotechnical parameters are very common in civil engineering on Earth. The plate load test (ASTM, 1998) and the direct shear test

* Corresponding author. Tel.: +86-13796621169; fax: +86-0451-86413857; E-mail address: jiangshy@hit.edu.cn