AUTO-GOPHER-2 (AG2) – AUTONOMOUS WIRELINE ROTARY PIEZO-PERCUSSIVE FOR DEEP DRILLING Yoseph Bar-Cohen[1], Mircea Badescu[1], Stewart Sherrit[1], Xiaoqi Bao[1], Hyeong Jae Lee[1], Shannon Jackson[1], Brandon Metz[1], Kris Zacny[2], Bolek Mellerowicz[2], Daniel Kim[2], Gale L Paulsen[2], [1]Jet Propulsion Laboratory, California Institute of Technology, (MS 67-119), 4800 Oak Grove Drive, Pasadena, CA 91109-8099, Phone 818-354-2610, yosi@jpl.nasa.gov, web: http://ndeaa.jpl.nasa.gov, [2]Honeybee Robotics Spacecraft Mechanisms Corporation, Pasadena, CA

Introduction: Reaching great depths on the moon for human's settlement, ISRU, and construction of infrastructure applications will require effective drilling mechanisms. The required drill has to meet mass, volume and energy consumption constraints and conventional technologies are limited in meeting them. To address the related challenges, a deep drill, called Auto-Gopher-2 has been developed jointly by the JPL's NDEAA laboratory and Honeybee Robotics Ltd. The Auto-Gopher-2 is a wireline rotary piezo-percussive drill that combines breaking formations by hammering using a piezoelectric actuator and removing and collecting the cuttings by rotating a fluted bit. The hammering is produced by the Ultrasonic/Sonic Drill/Corer (USDC) mechanism that has been developed by the JPL team as an adaptable tool for many drilling and coring applications. The USDC uses an intermediate free-flying mass to convert high frequency vibrations of a piezoelectric transducer horn tip into lower frequency hammering of the drill bit. The USDC concept was used in a previous task to develop an Ultrasonic/Sonic Ice Gopher and then integrated into a rotary hammer device to develop the Auto-Gopher-1. The lessons learned from these developments were implemented into the development of the Auto-Gopher-2, an autonomous deep wireline drill with integrated cuttings management and drive electronics. Subsystems of this wireline drill were developed in parallel at JPL and Honeybee Robotics Ltd. The AG2 system was field tested by drilling in a consolidated gypsum formation and reached 7.52 meters deep. In this paper, we present the latest developments as well as the results of the laboratory and field tests.

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