GITAI R1 ROVER FOR LUNAR EXPLORATION AND BASE CONSTRUCTION. S. Higa[1], Y. Furuta[1], Y. Tada[1], S. Nagasaka[1], S. Inoue[1], A. Shibata[1], K. Kawagoe[1], H. K. Tang[1], T. Kozuki[1], , R. Ueda[1], K. Nakamura-Messenger[2], Y. Nakanishi[1] and S. Nakanose[1] [1]GITAI Inc. 1-20-13 Haneda, Ota, Tokyo, Japan, [2]GITAI USA Inc. 2255 Dominguez Way, Torrance, CA 90501. (keiko.m@gitai.tech)

GITAI provides labor in space: GITAI Inc.[1] is developing general-purpose robots for a wide range of tasks in the harsh space environment. In the short time since its founding five years ago, GITAI successfully executed a robotic arm demonstration in the International Space Station[2]. Another arm demo is scheduled outside the ISS in 2023. GITAI is also a partner for developing a pressurized lunar rover with Toyota, as part of an agreement between JAXA and NASA.

GITAI (meaning "ghost in the shell" or "human mimicry" in Japanese) is developing robots to perform and/or support astronaut EVA activities, including assembly, inspection, maintenance, and repair in orbit and on the lunar and martian surface. GITAI robots will lower mission costs and promote crew safety by reducing crew exposure to hazards.

Here we describe GITAI's versatile R1 lunar rover, designed to support activities including payload mobility and deployment, sample collection, in situ resource utilization support, and lunar base construction.

Control modes: Capabilities include both remote virtual reality control and autonomous action.

Dual 8-degree of freedom arms with grapple end effectors: These can perform simple, repetitive, or time-consuming precision operations such as offloading support, mating connectors, and off-loading support capability (Fig.1).

Fig. 1: Offloading support of a large structure by GITAI R1 Rover robot at JAXA/ISAS lunar test field; R1 successfully removed shackles and slings from the structure.

Mobile arm with tool changer (Fig.2, 3): Developed by GITAI, this arm has the capability to reposition itself to multiple grapple fixtures on the rover and lander. It achieves this by "walking" end over end from one fixture to another (Fig.2). The arm can receive power and data from either end. It can perform a wide range of tasks including excavating, chipping (Fig.3), and sampling (scooping regolith and picking rocks) and deposition into a collection mechanism.

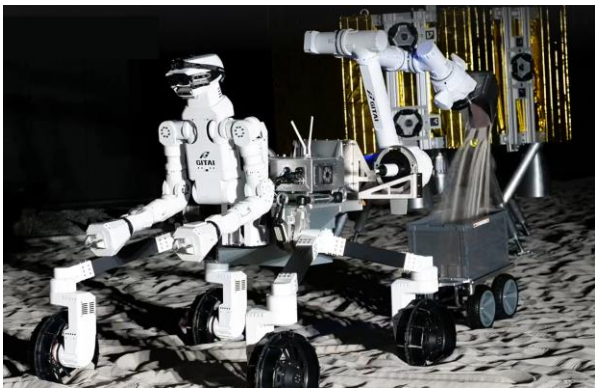

Fig. 2: GITAI R1 rover with a re-positionable arm, pouring sandy sample into a sample container.

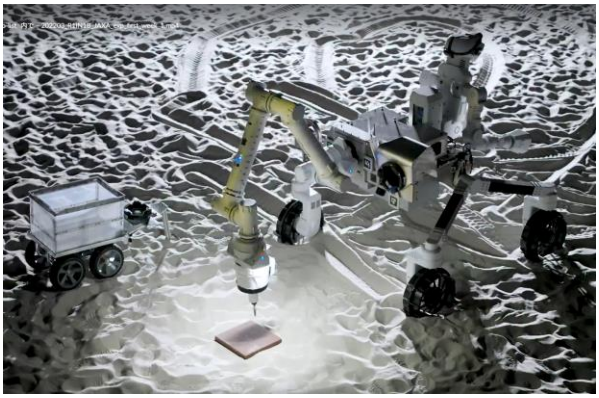

Fig. 3: percussive sample fragmentation. All images are real demonstrations, not renderings.

The future: An upcoming NASA CLPS call will be for delivery of a payload to the Moon's Gruithuisen Dome site. Some elements of this payload must be rover mounted in order to achieve their science goals. NASA has announced that the "rover will be provided by the winning lander vendor [3]." The GITAI R1 is ideally suited to this role.

GITAI has a strong record of rapid development of highly capable robotic systems for flight, mainly due to our all-in-house approach to both hardware and software. GITAI can accommodate aggressive schedule and technical needs, including end to end integration and immediate software adjustments.

References: [1] https://gitai.tech/en/ [2] NASA Press Release (2022) [3] NASA Press Release