Breadboard Model of Bionic Legged Robot for Lunar Lava Cave Exploration

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Recently, some large, deep vertical holes were discovered at Marius Hills, *Mare Tranquillitatis*, and *Mare Ingenii* on the lunar surface by Japanese spacecraft SELENE (Kaguya) using lunar surface image data acquired by the Terrain Camera (TC) (Haruyama et al., 2009; Robinson et al., 2012; Kaku et al., 2017). Lunar lava tubes can play an important role in both science and human exploration. They might be ideal sites for future lunar bases, because of their stable thermal conditions and potential to protect people and instruments from micrometeorites and cosmic ray radiation. Their stable and protected environment also makes them an enticing research target: original lava compositions, textures, and even magmatic volatiles are expected to be preserved in pristine condition within these lava tubes (Haruyama et al., 2012; Haruyama et al., 2016). Examining their interiors could provide unique insights concerning the evolutionary history of Moon. In the future, we will expand our search to other regions on Moon where additional subsurface lava tubes may be discovered. In this study, we have been developing the lunar exploration robot. We believe using a bionic mechanism with intelligence will be more stable for complex rocks than a wheel mechanism in the lunar environment. Our robot has individual motors for every single joint compared with other legged robots, hence it has higher flexibility. However, for the prototype to safely and efficiently explore lunar caves, certain conditions are required: 1. Stability of the survey instrument in space and cave environment 2. the optimum size of robot and onboard instruments, 3: Autonomous control under lunar cave. Currently, we have developed a reinforcement learning method for the robot. This presentation will introduce the current status and highlights of our bionic legged robot, including mobility, flexibility and agility. To test the function of the survey instrument, we are creating a simulated environment of lunar caves. We will also improve the balance system of the robot by testing it in the simulated environment, and ensure its functionality during a real exploration on the moon. The results of these experiments will be published at JpGU-AGU joint meeting 2020.

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