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JUMP ROBOT WITH TETHER FOR LUNAR VERTICAL HOLE EXPLORATION

Abstract

Observation data captured by Japanese lunar orbiter spacecraft SELENE revealed that on the moon there are some terrains called "vertical holes" with larger depth-diameter ratio than that of normal craters. The hole has an overhanging part and a space like a cavity spreads under it. Then, it is also expected as a future candidate sites for underground resource exploration and lunar base, and so on. However, the details of the hole or the cavity of the moon has not been disclosed and it is required strongly to explore them. For the purpose of exploring them, the UZUME project (JAXA) is being advanced in Japan. In order to investigate them, it is supposed to introduce a system which consists of a main rover and a sub rover. The main rover is put in the vicinity of the hole entrance, and the sub rover is connected to the main rover by tether which is used as communication line, power line and lifeline. The sub rover descends into the hole by the use of the tether and reach the bottom of the hole in order to investigate the hole and the cavity.

In this study, a jumping system as a sub rover is proposed, and two reaction wheels for attitude control and an actuator for storing energy for jump are equipped in it. However, since the influence of the tether on the movement of the sub rover is quite large during the jumping movement, this study also proposes a control law for jumping that cancels the influence of the tether. The control law requires state information of the tether and the information is estimated by Kalman filter using the sensing data of the measurement device installed in the sub rover. Furthermore, a test bed simulating the environment on the moon surface is constructed, experiments using the prototype of the proposed system are conducted, and the effectiveness of the system is verified.