Paper ID: 58314
student

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

Author: Dr. Yufei Guo
Northwestern Polytechnical University;National Key Laboratory of Aerospace Flight Dynamics, China, guoyfzyyy@163.com

Prof. Jianping Yuan
National Key Laboratory of Aerospace Flight Dynamics,Northwestern Polytechnical University,Xi'an, China, jyuan@nwpu.edu.cn
Dr. wang mingchao
Northwestern Polytechnical University;National Key Laboratory of Aerospace Flight Dynamics, China, 2019100053@mail.nwpu.edu.cn
Dr. Jing Fang
National Key Laboratory of Aerospace Flight Dynamics,Northwestern Polytechnical University,NPU, China, shdjnfj@163.com
Dr. Zixuan Zheng
Northwestern Polytechnical University;National Key Laboratory of Aerospace Flight Dynamics, China, z.zheng@nwpu.edu.cn

A KANGAROO-INSPIRED LUNAR HOPPING ROBOT WITH THE RIGID-FLEXIBLE COUPLING MECHANISM

Abstract

Considering abundant resources and unique environment, the moon has become a natural space station for human beings to explore the universe. On the 50th anniversary of the first moon landing of mankind, the world has ushered in a new wave of lunar exploration. According to the development trend of international lunar exploration, the construction of the permanent lunar base has become the ultimate goal after unmanned lunar exploration missions and manned lunar exploration projects. In the construction process of a lunar base, lunar robots will become the main labor force. However, the complex topography of the moon, the soft lunar soil, and the low-gravity environment will increase the movement difficulty of robots. Among various types of robots, hopping robots can make good use of the low-gravity environment of the moon, and they have advantages on strong obstacle surmounting ability, flexible movement, and small landing area. Therefore, hopping robots are more suitable for the unstructured environment of the moon.

At present, the kinematic stability and energy utilization efficiency of jumping robots are the main factors that restrict their jumping performance, environmental adaptability, and practicability. In nature, kangaroos use flexible spines to keep its fast, robust, and low energy jumping movement. This fascinating biological structure inspires an idea of proposing a bionic lunar hopping robot with flexible spine in this paper. This hopping robot adopts a rigid-flexible coupling mechanism model. Its deformable flexible spine provides additional degrees of freedom for the torso movement, and the up and down bending of the torso increases the flexibility of the bionic kangaroo robot in the irregular terrain of the moon. Compared with bionic hopping robots with rigid torso, the hopping mechanism model proposed in this paper can adjust the force distribution of the robot's body through the compliant deformation of the spine, thereby improving the speed, stability and energy utilization efficiency of the robot's hopping in the lunar environment.