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AN INDOOR LUNAR ANALOGUE FACILITY FOR TESTING LUNAR HETEROGENEOUS SWARM ROBOTS

Abstract

Considering high synergy, efficiency, scalability and flexibility, heterogeneous swarm robots will play an important role in sustainable lunar activities. However, the characteristics of the lunar topography, lunar regolith, lunar dust and lunar illumination will bring great challenges to the operation of lunar robots. In order to ensure that the lunar robots can successfully complete major tasks such as detection and base construction in the complex lunar environment, it is required to carry out a large number of tests and verifications during the development of lunar robots, and the test environment should reproduce the lunar surface environment as realistically as possible. Therefore, we have built a total area of $14m \times 19m$ indoor lunar analogue testing facility to test the performance of lunar swarm robots in slope climbing, obstacle surmounting, positioning, path planning, cooperative operation, etc. This facility includes three functional areas: the test area, the installation area and the control area. The installation area is used for temporary assembly and on-site maintenance of lunar robots. The subsystems of our facility include a lunar topography simulation system (a $10m \times 10m$ sandbox filled with lunar regolith simulants), a lunar illumination simulation system (two scenarios of direct and oblique illumination), a cosmic background simulation system, a slope system with adjustable angle between $0°$ and $45°$, a flatcar operating system, a motion capture system, an environmental drying system and a monitoring system, etc. By using the flatcar operating system, the construction of the lunar topography is safer, faster and more accurate. Compared with most existing lunar analogue test facilities, the lunar simulation environment provided by our facility is more comprehensive and high-fidelity, which can test various performances of lunar heterogeneous swarm robots.