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Author: Dr. Jun Jiang
Shanghai Engineering Center for Microsatellites, Chinese Academy of Sciences (CAS), China, hitchevalier@hotmail.com

Mr. Bo Zhang
Shanghai Engineering Center for Microsatellite, China, ghostdang@163.com
Ms. Qingyun Mao
Innovation Academy for Microsatellites, Chinese Academy of Sciences, China, qymao88@hotmail.com
Mr. Ming Guo
Shanghai Engineering Center for Microsatellites, Chinese Academy of Sciences (CAS), China, googlm@163.com

ELECTROMAGNETIC-RECONFIGURATION ON-ORBIT VERIFICATION BY CUBESAT FOR FUTURE LARGE SPACE STRUCTURE CONSTRUCTION MISSION

Abstract

It is difficult for traditional rendezvous docking technology to be applied to smaller spacecrafts such as cube-sat, because of much propellant and complex mechanisms for relative navigation, flexible docking and separation. The contactless inter-satellite electromagnetic force, with its feature of less propellant consumption, no plume contamination, and low impact, is a potential approach to satellite-satellite rendezvous docking. In our previous research, the new technology called electromagnetic reconfiguration including electromagnetic docking/separation and high-precision navigation has been proved the feasibility via air bearing experiment in the lab. However, it is still necessary to operate on-orbit mission to verify the electromagnetic reconfiguration technology. The on-orbit verification proposed makes use of two 12U CubeSats (less than 20 kilograms per satellite) rendezvous docking with each other for proving the electromagnetic reconfiguration technology can be used in future large space structure construction. The two satellites designed and manufactured by Chinese academy of science will be launched in June, 2021. Following satellite-rocket separation in sun-synchronous orbit, the electromagnetic reconfiguration verification will be executed based on laser communication/measurement integrated system for inter-satellite and satellite-ground, visual navigation system and electromagnetic docking/separation system. Firstly, two satellites formation will fly at less than 10 Kilometers apart. And then, two satellites will rendezvous with laser devices above from 10 Kilometers to 5 meters. Lastly, the electromagnetic docking will be executed with the help of the laser devicea distance of 5m to 2m,visual device(a distance of 2m to10mm) and electromagnetic docking device. The record will be acquired by camera mounted in satellite and transferred to ground with laser communication/measurement integrated system. With the laser communication/measurement integrated system developed, the indicators are 2mm and 0.5 degree, respectively for ranging accuracy and the angle accuracy inter-satellite between 20 kilometers and 2 meters. With visual navigation system developed, the indicators are 0.3mm and 0.2 degree, respectively for ranging accuracy and the angle accuracy inter-satellite between 2 meters and 10mm. With the electromagnetic docking system developed, the relative velocity inter-satellite can be reduced to 10mm/s.