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GLOBAL MISSION FOR 3D IONOSPHERE MAPPING VIA CUBESAT CONSTELLATION

Abstract

Many satellites already measured ionosphere density in LEO region and still this information is not enough to create a global 3D ionosphere map. The ionosphere constantly fluctuates in a global scale, which is a complication in the process of its re-creation. To improve and validate ionosphere numerical models, measurements taken by the individual satellite are used. To measure the total electron content (TEC), and have higher spatial and temporal resolution, higher accuracy and lower cost in comparison to Global Navigation Satellite System (GNSS), we propose a CubeSat constellation. With 1000 satellites on the different orbital planes in LEO, we can have spatial resolution of 15 km and a temporal resolution of 30 minutes. And the electron density distribution will be known by the solving the inverse problem from many observation provided by the constellation. These target values have, much higher accuracy than GNSS and can be achieved with much lower cost than using GNSS system. Inter satellite ranging is the next generation technology that also can improve the accuracy of GNSS positioning. The CubeSat constellation

is complimentary and integrated with GNSS. The observation data can be improved by adding the GNSS occultation data. The CubeSats need to know their own position, which will be done by the onboard GNSS receiver. Currently, the first path-finder satellite, SPATIUM-I, is under development and will be launched in 2018. SPATIUM-I will validate the key technologies that are based on the clock-signal phase-shift sent from the satellite carried Chip-Scale Atomic Clock (CSAC). The project is under development by the Laboratory of Spacecraft Environmental Interaction Engineering (LaSEINE) of Kyushu Institute of Technology in collaboration with Nanyang Technological University, Singapore. This paper will present the status of SPATIUM-I development and its preliminary flight results as well as the overview of the follow-on projects, SPATIUM-II and SPATIUM-III.