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A MISSION DESIGN FOR GNSS RO/R MICROSATELLITE CONSTELLATION

Abstract

In addition to the navigation application, the Global Navigation Satellite Systems (GNSS) are utilized in earth remote sensing techniques, including Radio Occultation (GNSS-RO) and Reflectometry (GNSS-R). GNSS-RO has been demonstrated its tremendous usages in atmospheric soundings by retrieving the temperature, pressure, and water vaper from the bending angle of GNSS signal while passing through the atmosphere. The most successful mission is FORMOSAT-3/COSMIC, launched in 2006, co-developed by Taiwan (NSPO) and US (UCAR). The FORMOSAT-7/ COSMIC-2 called for 12-satellite constellation is a follow-on GNSS-RO mission collaborating between Taiwan (NSPO) and US (NOAA) to replace the aged FORMOSAT-3/COSMIC. The space-borne GNSS-R technique, detecting reflected GNSS signal for the measurement of ocean surface wind speed, has been experimented and implemented in UK-DMC, SSTL-TchDemoSat, and NASA-CYGNSS projects. GEROS-ISS is a scientific experiment proposed to ESA to install both GNSS-RO and GNSS-R instruments onboard the International Space Station. In this study, a mission design for the GNSS RO/R mission utilizing microsatellite (or 12U cubesat) approach for collecting atmospheric and ocean surface roughness soundings simultaneously to enhance the severe weather prediction is presented. A constellation of 36 microsatellites orbiting to be deployed in 3 orbital planes is planned to increase the number of sounding profiles and agilely track the extreme weather events such as typhoons or hurricanes. The feasibility of utilizing miniaturized satellite technologies with a mass of 20kg is elaborated to provide a cost-effective approach for space access. The architecture of GNSS-RO/R payload instrument utilizing NSPO's in-house technique is introduced as well. The satellite designed with the inter-satellite link capability is implemented to shorten the data latency and decrease the number of ground station support. The presented mission design is the first-of-this-kind GNSS RO/R operational constellation system utilizing emerging and promising miniaturized satellite technologies and providing atmospheric sounding profiles and ocean surface wind speeds to be beneficial to weather predication, space weather, and climate change research communities, and produce profoundly societal impacts.