19th SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

Author: Prof. Rock Jeng-Shing Chern
University of Science & Technology, Canada, editor-in-chief@iaamail.org

Dr. An-Ming Wu
National Space Organization, Taiwan, China, amwu@nspo.narl.org.tw
Mr. Chieh-Ming Huang
University of Science and Technology of China, Taiwan, China, rob3small@yahoo.com.tw

OPTIMAL GLOBAL DISTRIBUTION OF OCCULTATION DATA FOR FORMOSAT-3 AND -7 TYPE CONSTELLATIONS

Abstract

This paper presents the orbital design to maximize the number of occultation data for the FORMOSAT-7/COSMIC-2 constellation, the follow-on program of the FORMOSAT-3/COSMIC constellation. After launched on 15 April 2006, 6 satellites of FORMOSAT-3/COSMIC carry propellant to raise themselves to 6 different orbital planes at 800 km altitude, 72 deg inclination and 30 deg right ascension of ascending node (RAAN) apart so that a constellation with global coverage is deployed. Onboard each satellite there is a GPS occultation experiment (GOX) receiver. About 3,000 occultation occurrences can be obtained per day and have been assimilated into numerical weather models for real-time weather prediction. Contribution of the constellation has been well recognized world wide. Therefore, the National Space Organization (NSPO) of Taiwan is planning the FORMOSAT-7/COSMIC-2 Program to be the follow-on of the FORMOSAT-3/COSMIC constellation. There are two defects in the current FORMOSAT-3/COSMIC system. The first defect is that 3,000 occultation data are not enough. The surface area of Earth is as large as 511,000,000 square meters. It means that averagely there is only one data per day in an area of 170,333 square meters or 412 km x 412 km. The second defect is that the occultation data density at low latitude belt, a belt where tropical activities are very high, is relatively low. Consequently, it is highly recommended to correct these two defects in the FORMOSAT-7/COSMIC-2 system. Different orbital configuration design provides different GOX result. A simulation has been done in a replenishment system of 6 satellites. Three inclination angles have been simulated. It is found that better data distribution near the equator region is obtained for the case of 0 deg inclination of the system. Therefore, if the 6 satellites are deployed with equal space in the inclination angle such as (1, 2, 3, 4, 5, 6)=(0 deg, 15 deg, 30 deg, 45 deg, 60deg, 75 deg), the global distribution of GOX data could be better. In particular, there should be more GOX data at low latitude near the equator regions. A replenishment system of 12 satellites in the FORMOSAT-7/COSMIC-2 constellation could be deployed with equally spaced inclination angle of 90/12=7.5 deg to obtain better global distribution of all GOX data. The orbital design for optimal global distribution of occultation data for FORMOSAT-7/COSMIC-2 constellation will be presented.