66th International Astronautical Congress 2015

22nd IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
16th UN/IAA Workshop on Small Satellite Programmes at the Service of Developing Countries (1)

Author: Ms. BLESSING ZINOM
National Space Research and Development Agency (NASRDA), Abuja Nigeria, Nigeria, zinomblessing@gmail.com

Mr. Abdul Lawal
School of Engineering, University of Glasgow, United Kingdom, 1004341l@student.gla.ac.uk

DESIGN AND PERFORMANCE ANALISIS OF SMALL SATELLITE SPACE SEGMENT CONSTELLATION FOR NEAR EARTH OBSERVATION AND COMMUNICATION

Abstract

Small satellite systems are considered a vibrant and emerging trend in satellite systems design. The utilization of satellites constellation to attain specific mission objectives is not a new event or occurrence. Small satellite trends are moving away from one-time stretch and moving in the direction of added frequent use in a constellation setting. Constellation design for small satellites allows the use of fewer funds for achieving larger functionality as large satellites. Most small satellites are developed with very high capability, rapid response, at low cost and reliable operations using latest commercial of the shelf (COT'S) products. Besides the benefit of low cost, another justification for miniaturization of satellites is the avenue created which allows the realisation of implementing missions where larger satellites could not accomplish, such as: Constellations for low data rate communications, using satellite formations for gathering data from multiple points, in-orbit inspection of larger satellites and research in different capacities. This paper discusses a set of mission requirements proposed for experimentation by the center for Satellite Technology Development (CSTD) in the quest to meet the center's annual policy mandate. In view of the aforementioned, the paper analyzes the design and performance of a Small Satellite Space Segment Constellation (SSSSC) for near earth observation and communication respectively. Each satellite within the constellation is designed to have a total mass of 10kg, and can be classified as a Nano-atellite. The orbit design of the constellation will be modelled using MATLAB and results validated with the Satellite Tool Kit (STK) software. The constellation consist six of small satellites carrying different types of payloads namely: optical camera for Earth observations, magnetometer for measuring the Earth's magnetic field and a transmitter/receiver for inter-satellite and other communication purposes. To this end, this work describes the constellation orbit parameters and satellite station keeping requirements. Furthermore, it presents link budgets, as a basis for checking the performance of each satellite. The link budgets presented are for: inter-satellite link, uplink and downlink. Hereafter, the paper evaluates the data capture and transfer rates of each satellite as a means of verifying the robustness of the design in view of meeting the mission requirements. Finally the advantages and disadvantages of implementing a small satellite constellation for near earth observation and communication will be discussed.

Keywords: Small Satellites, Space Segment, Constellation, Communication, Observation, Satellite Systems, Data rate.