Paper ID: 73064
student

IAF EARTH OBSERVATION SYMPOSIUM (B1)
Interactive Presentations - IAF EARTH OBSERVATION SYMPOSIUM (IP)

Author: Mr. Vladyslav Bohlachov
University of Luxembourg, Luxembourg , vladyslav.bohlachov.001@student.uni.lu

Mr. Elliott Wobler
University of Luxembourg, Luxembourg , elliottwobler@gmail.com
Mr. Tiago De Jesus Sousa
University of Luxembourg, Luxembourg , tiago.dejesus.001@student.uni.lu
Mr. Balazs Farkas
University of Luxembourg, Luxembourg , balazs.farkas.001@student.uni.lu
Mr. Spyridon Skevas
University of Luxembourg, Luxembourg , spyridon.skevas.001@student.uni.lu
Dr. Jan Thoemel
University of Luxembourg, Luxembourg , jan.thoemel@uni.lu

THE "DAFFODIL" MISSION: GNSS-REFLECTOMETRY WITH A 1.5U CUBESAT

Abstract

The conceptual Daffodil mission employs a 1.5U cube satellite to perform Earth observation using GNSS-Reflectometry (GNSS-R). In its current stage, Daffodil is a feasibility study and simulation implemented within the Simulink software platform. Existing COTS subsystem components have been selected based on mission requirements and constraints in order to meet the science goal of mapping all inland water bodies greater than 300 km2 between the latitudes of 23.3 N and 66.3 N. This is achieved using a LEO orbit between 400 km and 600 km altitude, with a 10:30 LTAN/LTDN. Subsystem engineering and trade-off evaluation has been completed with consideration of the total system mass, power, and data budgets - but without consideration of financial cost at the present time. The AGI STK simulation tool was used to define the exact parameters of the mission regarding power generation capabilities and communications. Hardware and design optimization were conducted using concurrent engineering approaches. For mission design with the CubeSat Simulator, subsystems were first designed separately using MATLAB Simulink. Simulink's CubeSat Simulator was then used as the frame to integrate all subsystems into a single mission simulator. Within this simulation the Daffodil satellite positions itself for ideal power generation when nadir-pointing is not necessary to fulfill the science goals. This allows for a battery surcharge, used up during payload functions in eclipse. Communications occur during daytime to ensure a balanced power budget. Specular point location is calculated using a modern approach developed by researchers at the Australian Centre for Space Engineering Research. For the downlinking of science data, assuming there is one ground station in Luxembourg and another in Quebec, S-band can be used instead of UHF to ensure an optimal data/energy ratio. In addition to sizing calculations and simulated operations, a CAD model of the Daffodil spacecraft has been created with FreeCAD which integrates all subsystem components into a single unified view.