44th STUDENT CONFERENCE (E2)
Student Team Competition (3-YPVF.4)

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TWO SATELLITE DESIGNS INTEGRATING A HYBRID INTERFEROMETRIC SYNTHETIC APERTURE RADAR FOR EARTH OBSERVATION

Abstract

The focus of this study is to compare the satellite designs developed by two teams of eight 4th year undergraduate students at the University of Bristol. The project was conducted in association with *Astrium UK* (now *Airbus Defence & Space*), to produce a system concept for a mission candidate for *ESA's*

Earth Explorer 9 programme. The low-Earth orbit satellite, named *WAVEMILL*, is to be launched in 2025 from Kourou, French Guiana, with a nominal five year mission duration. It aims to map the Total Surface Current Vector of the Earth's oceans, coasts and inland waters, with unprecedented high resolution. This would allow scientists to model the ocean-atmosphere climate system, and improve understanding of global climate change. The payload is a state-of-the-art hybrid interferometric Synthetic Aperture Radar, with demanding power and data handling requirements of 3.4 kW and 2 Gbits/s respectively. This was to be integrated into a spacecraft that met the mass and volume constraints of the *Arianespace VEGA* fairing.

The project was intended to be a two-way exchange of ideas; Astrium challenged the students with an ongoing real-life problem, and in exchange, would receive a series of innovative engineering solutions. Each team produced a single conceptual design in the space of 12 weeks, and was composed of the following subsystems: Mission Analysis, Configuration, Power, Thermal, Payload, AOCS, Propulsion, Communication & Data Handling, Structures. Both teams used STK for orbit coverage analysis, ESATAN to perform thermal modelling, and Autodesk Inventor to configure the components of the spacecraft. MATLAB & Simulink provided battery discharge and AOCS orbit disturbance modelling.

The paper will present the two designs and compare and contrast their different features. Team 1 produced a hybrid electric/chemical propulsion system with a composite structure, which made use of embedded fibre Bragg gratings to measure the thermal strains in the antenna booms. Data was first compressed before being transmitted to the ground through a radio-frequency helix antenna. Team 2 opted for a purely chemical propulsion system, with a hybrid aluminium/composite structure. The antennae were dropped below the satellite such that the distance between them could be measured directly using a laser array, and the raw data was transmitted to the ground through a laser link with the *European Data Relay System*. Ultimately, the paper will discuss how the students, not yet in industry, have approached a real-time aerospace specification.