31st IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Constellations and Distributed Systems (7)

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HYDROSWARM – USING A COOPERATIVE SWARM OF CUBESATS TO ENHANCE GNSS-R CAPABILITIES FOR SURFACE SOIL MOISTURE AND INUNDATION MEASUREMENTS.

Abstract

HydroSwarm is a CubeSat formation flying mission, the feasibility of which is currently being studied under the ESA Open Space Innovation Platform (OSIP) campaign "Innovative Mission Concepts Enabled by Swarms of CubeSats". The controlled separation of spacecraft in the formation will allow novel data processing techniques to be used to generate side-by-side ground tracks, increased SNR, and the generation of SAR like images. These new GNSS-R modes will complement larger L-Band SAR and microwave radiometer missions to increase our knowledge of soil moisture and inundation.

The study is investigating different modes, the benefits they each have with regards to GNSS-R measurements and the requirements they each place on the mission. Of particular interest at this stage are the constraints placed on the CubeSats with regards to the guidance and navigation strategy to maintain and operate the formation. The position knowledge accuracy is critical for the imaging mode of the formation, and as such is driving the navigation solution. Differential GNSS techniques are being explored to assess their suitability for this mission. The need for across-track separation in the formation is driving the selection of the formation control and guidance strategy towards a Projected Circular Orbit formation. The different formation configurations are being analysed to estimate the required fuel to operate the swarm.

The high data rates from raw RF collections are limiting the capture period and driving the solution for the data pipeline. Areas such as the Amazon rainforest are considered ideal to demonstrate these new techniques, and the mission is therefore focusing on collections over this area.

Critical aspects for the Concept of Operations are also considered. This includes the initial deployment and initial formation, as they are major drivers of the mission's delta-V budget, in addition to the safe mode operations of the formation.

This paper will describe the outcomes of this feasibility study, and the potential for swarms of CubeSats to be used to generate novel data products which will allow for improved measurements of global hydrological conditions.