Paper ID: 72860
student

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

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# ANALYSIS AND DESIGN OF FUTURE MULTIPLE SATELLITES FORMATION FLYING L-BAND MISSIONS IN LOW EARTH ORBIT

**Abstract**

In the context of future L-band missions, the need to improve the spatial resolution with respect to the ESA's Soil Moisture and Ocean Salinity mission should be addressed for future follow-on studies with a range of applications over land and oceans. Since November 2009, SMOS has been producing global maps of soil moisture and sea surface salinity with an average resolution of 40 km, which play a key role in the improvement of meteorological and climate monitoring and prediction. Future mission studies should address the need for a resolution down to 1-10 km. Such improvement in the resolution of a radiometer can only be obtained by increasing the aperture size with either a bigger satellite or a formation of multiple platforms working as distributed node of a sensor of network. In this paper, the latter strategy is envisioned as a potential way to improve spatial resolution. Starting from the outcomes of the Formation Flying L-band Aperture Synthesis (FFLAS) study concept, proposed by the European Space Agency, this paper addresses novel formation geometries, considering multiple satellites acting as distributed radiometer sensors. Specifically, up to six identical platforms are envisioned to improve spatial resolution. Considering the scientific mission requirements of the L-band interferometer, tight and rigid formation geometries are studied for Low Earth Orbit application. First, possible configurations are analysed in the local orbital frame to minimise the effect of orbital perturbations and to balance the fuel consumption among the platforms. To fulfil the requirements of the L-band interferometer, the requirement in the typical distance among the satellites is in the order of meters, which poses a great challenge in terms of control strategies and safe mode definition. The maintenance of a rigid formation to perform aperture synthesis is achieved by a continuous control thrust with electric propulsion engines. The relative dynamics are propagated with a high-fidelity environment, including the main perturbing effects of the LEO region. As demonstrated by the FFLAS study, control accuracies in the centimetre order can be reached thanks to the design of a robust control strategy. At the same time, guidance and navigation strategies are presented to assess the feasibility of the study, in terms of both navigation and control accuracies. Finally, the paper presents possible safety strategies for different operational scenarios, to fulfil with inter-satellite collision avoidance requirements.