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CLOUD CT - DESIGNING A NANOSATELLITE FORMATION FOR MULTI-VIEW CLOUD TOMOGRAPHY

Abstract

Warm shallow clouds are present in a variety of environmental states and aerosol loading scenarios. Though they are important for climate prediction, former measurement technologies are not able to retrieve their properties. The project CloudCT will design and implement a nanosatellite formation for multi-view cloud tomography using a 3D atmospheric scattering retrieval approach with optical sensors. The satellite instrument is a major system driver and influences the attitude and orbit control system which enable the novel multi-view observation technique.

The attitude and orbit control system is responsible to maintain the satellite formation and perform the required pointing strategy such as target tracking or a scatter-angle dependent geometry, which is fixed with respect to the sun. However, observations and formation maintenance are not possible at the same time. The formation control system has therefore the objective to maximize the observation time.

In mission analysis, various system variables play a role. The instrument has a field-of-view and sensor/pixel size. The orbit altitude determines the resulting swath width and ground sampling distance. A low orbit altitude is beneficent in many ways: it either improves swath and ground sampling distance or allows the integration of a less complex, and therefore more affordable system. At the same time, the pointing accuracy required to observe an overlapping area is reduced. As the requirements on observation angles are constant, the observation baseline (the maximum distance between the formation satellites) is reduced and the intersatellite link budget benefits from a reduced intersatellite distance (the distance between two adjacent satellites). However, in a low orbit environment the orbital disturbances due to aerodynamic drag increase and therefore the requirements to a propulsion system become more challenging.

This contribution summarizes the relationships between the described system variables and provides study and simulation results regarding the formation and attitude control system considering various orbit altitudes as well as instrument parameters. In conclusion, the results are evaluated and a preliminary system design, which optimizes observation quality and output, is presented.

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