32nd IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Small Space Science Missions (2)

Author: Mr. Leon Schiltz
European Space Agency (ESA-ESOC), Germany

Ms. Rosie Wilson
European Space Agency (ESA-ESOC), Germany
Mr. Mehdi Scoubeau
European Space Agency (ESA-ESOC), Germany

MODELLING IN SITU MAGNETIC FIELD MEASUREMENTS OF THE AURORA-D SPACECRAFT USING THE MAGPYLIB LIBRARY

Abstract

Accurate in situ measurements of the Earth's magnetic field are crucial for understanding the magnetospheric currents which produce aurorae, as well as for monitoring geomagnetic storms – key goals of the ESA Aurora mission. However, these measurements are often affected by interference from spacecraft components such as magnetorquers, batteries, onboard computers, and solar arrays. Traditional solutions require either a magnetically clean platform or a long boom on which to position magnetometer sensors far from the spacecraft – both of which increase development time, complexity, and therefore mission costs.

The Aurora mission is a small satellite constellation aiming to provide continuous monitoring of the auroral oval for operational space weather applications. The initial demonstration mission, Aurora-D, involves a single spacecraft in a polar Medium Earth Orbit. Aurora-D's payload suite includes two magnetometers, one on the spacecraft panel and the other one mounted on a boom, in order to provide information on the underlying geo-magnetic state conditions in the Earth's lower magnetosphere. Aurora-D will also image auroral emissions in the optical and UV bands and carry several radiation monitors.

This paper aims to report on simulation efforts in order to enable system trade-offs and requirement assessment. Given the project phase, the simulations are not meant to be fully representative but to provide conservative figures to answer questions regarding feasibility of accuracy, boom length, alignments and data processing needs.

An accessible and low-cost technique is demonstrated for modelling spacecraft magnetic cleanliness in 3D using open-source python libraries such as Magpylib. Key spacecraft components are modelled as magnetic dipoles, and their sum is combined with the Earth's local magnetic field along Aurora-D's orbit, as calculated from the IGRF-14 model. A prediction is thus made of the field components measured by the magnetometer sensors at the base and end of the boom, so as to verify that the spacecraft contributions do not drown out Earth's local magnetic field signature. Several techniques for minimising the interference of spacecraft-generated disturbances can be applied to optimise Aurora-D's magnetic cleanliness, for instance, altering the magnetometer boom length and implementing a cleaning algorithm. Results of this study will influence design choices in the Aurora phase B1 consolidation study that is currently underway, led by OHB Sweden and ESA's Space Weather Office.