

# The effects of polar magnetic field aligned currents on the attitude control system of low earth orbit satellite FEDSAT

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## ABSTRACT

Attitude accuracy is a significant issue for satellites carrying scientific magnetometry payloads. At Low Earth Orbit (LEO), an error in pointing accuracy of 0.5 degrees can translate to an error in measured magnetic field components of up to 350nT. Whilst slow variations in attitude error can be relatively easily removed when studying smaller scale features of the geomagnetic field, removal of the effects of more rapid variations in attitude error present a considerable challenge.

As part of quality and performance checks in the commissioning phase of the FedSAT LEO satellite, a statistical study was undertaken into the occurrence of FedSAT Attitude Control System (ACS) pointing errors, and their occurrence in relation to various scale field-aligned current (FAC) structures. FACs manifest as large perturbations to the geomagnetic field in the polar regions, and are one of the main research objectives of the NewMag magnetometer onboard FedSAT.

This study found a strong coincidence of ACS pointing errors with the locations of persistent large-scale FAC in the polar regions. It also found little obvious effect on the ACS from intense small-scale FAC structures below spatial scales of ~20km. The effect of large-scale FAC regions is enhanced during periods of high geomagnetic activity when the FACs are significantly strengthened.

This study has implications for the design of attitude control systems for small satellites carrying payloads with high attitude accuracy constraints, and their reliability in regions such as near the poles where large magnetic field gradients exist.