GRACE-FO and Swarm accelerometers: An optimal approach for processing non-gravitational acceleration measurements.

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Abstract

GRACE-FO (GFO) and Swarm are two LEO missions that, among others, provide non-gravitational acceleration measurements required for geopotential model development and modelling of non-gravitational forces acting upon them. Unfortunately, the performance of the accelerometers on board for both missions is not the expected. Measurements from both missions present dominant bias jumps that occur on all accelerometer axes and they have been linked to the satellites' entrance to and exit from the Earth's shadow. These jumps are estimated and corrected at Level 1A of GFO C and at Level 2 of Swarm C in an optimal way using Least Squares methodology. The corresponding variances of the jumps are also calculated. Furthermore, the measurements contain spurious signals and dominant spikes mostly connected with thruster activation, mainly in the equatorial region or high temperature sensitivity. These disturbances have a significant impact on the data analysis. We propose an alternative weighting filter methodology to generate Level 1B data from Level 1A for GFO C that includes the attenuated spikes and their corresponding variances and does not involve the removal of the spikes nor does it include any interpolation to fill data gaps. This methodology is used for Swarm C accelerometer Level 2 dataset as well. Using spectral domain methods, we show that the newly generated GFO Level 1B and Swarm Level 2 data are not contaminated by the presence of spikes and data jumps. In the polar regions, mostly at the South pole, spikes in the measurements are connected to magnetic disturbances when the satellites enter these regions. Our proposed methodology contains an optimal and unbiased dataset of non-gravitational acceleration measurements that can be used for the estimation of geopotential models and also for the investigation of the accelerometer's response to electromagnetic disturbances and the modelling of other non-gravitational accelerations to derive thermospheric neutral densities.

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