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Improvements in the GOCE Level 1b Gradiometer Processing

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The two most important and likewise most complex parts of the GOCE gradiometer processing are the step for correction of some gradiometer imperfections with the so-called Inverse Calibration Matrices (ICMs) and the step for the determination of the angular velocities of the spacecraft about the gradiometer axes.
With the application of the ICMs the gradiometer data is corrected for some small measurement errors, e.g. due to changing scale factors of the accelerometers or misalignments of the accelerometers within the gradiometer assembly. If the ICMs are not perfectly correct, e.g. because the scale factors vary with time, some influence of the measurement errors can remain in the gradiometer data.
The determination of the angular velocities is done in a step called angular rate reconstruction. It is performed by combining the available gradiometer and star sensor attitude information. The gradiometer measurements are best within a frequency range from 5 to 100 mHz, the so-called gradiometer Measurement Band Width (MBW), whereas the star sensors are very accurate for low frequencies. Therefore, to find the best angular rate estimation over the entire frequency range, a combination between the two sets of attitude information has to be done.
In this paper, possible updates within the ICM correction step and the step for angular rate determination are presented. The time dependency of some ICM elements is investigated and taken into account in the processing by linear interpolation of the ICMs in between two consecutive satellite shaking phases. For the angular rate determination step, an improved method is used, which performs an optimal combination between star sensor and gradiometer data. The improvements in the gravity gradients are illustrated in terms of the achievable gravity field accuracy. Therefore, several numerical scenarios, starting from the gradiometer control voltages up to the level of gravity field solutions, are performed.