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Combination of GRACE star camera and angular acceleration data

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The GRACE (Gravity Recovery and Climate Experiment) satellite mission provides K-band ranging (KBR) measurements between the two twin satellites GRACE-A and GRACE-B for the purpose of gravity field recovery. The KBR system measures the range between the two satellites' KBR antenna phase centers. To convert the original ranging observation to a distance between the two satellites' center of mass a geometric correction (antenna offset correction) has to be added, which depends on the inter-satellite alignment. Therefore, the precise inter-satellite pointing is one of the essential requirements for the KBR ranging.
Although the accuracy of gravity field solutions has increased during the last years, there still remains an offset between the present error level of gravity field solutions and the GRACE baseline accuracy, i.e. the predicted accuracy from pre-launch simulations. Pointing variations are one of the potential contributors to the error budget. Unmodeled errors in the Level-1B data products related to the alignment seem to have an influence on the recovered gravity field solutions. Furthermore, the improved understanding of the attitude data and/or possible error sources is essential for follow-on missions where higher accuracies should be achieved.
Up to now, the attitude determination and the alignment between the two satellites was carried out solely by the two star cameras on board each spacecraft. However, the accelerometer provides additional attitude information in terms of angular accelerations. Therefore, we combine both angular accelerometer and star camera data (ACC1B, SCA1B) in a least squares approach to improve the satellites' attitude estimation. The optimal combination of both data types (angular accelerations and quaternions) is achieved by means of variance component estimation (VCE). Subsequently, the antenna phase center can be re-estimated. The purpose of the presented work is to investigate the assets and drawbacks of this type of sensor fusion.