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Gravity field determination using the acceleration approach - Considerations on numerical differentiation

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One method for gravity field determination is satellite-to-satellite tracking(SST) in high-low mode. Therefore GPS (Global Positioning System) observations are used to estimate precise orbit positions and these are then used to gain the desired information about the earth's gravity field. In this context several approaches exist. One of them is the so called acceleration approach. It is based on newton's second law of motion and relates accelerations of the satellite to the gravity gradient. An important part of this approach is to derive the accelerations from precise satellite positions. This is done by means of numerical differentiation. Different methods for the task of numerical differentiation, like for example polynomial interpolation or Newton-Gregory interpolation, were investigated. In particular the methods were investigated concerning their differing properties and their impacts on the resulting gravity field solutions. These examinations were carried out mostly in the frequency domain, because this can be directly related to the spectral content of a gravity field solution. In the framework of this project several closed-loop simulations were made to find the best suited differentiation scheme. Afterwards the findings were applied to real data of the GOCE satellite. The results of our simulations and of real data applications will be presented.