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Time variable gravity retrieval and treatment of temporal aliasing using optical two-way links between GALILEO and LEO satellites

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For the determination of temporal gravity fields satellite missions such as GRACE (Gravity Recovery and Climate Experiment) or CHAMP (Challenging Minisatellite Payload) were used in the last decade. These missions improved the knowledge of atmospheric, oceanic and tidal mass variations. The most limiting factor of temporal gravity retrieval quality is temporal aliasing due to the undersampling of high frequency signals, especially in the atmosphere and oceans. This kind of error causes the typical stripes in spatial representations of global gravity fields such as from GRACE.

As part of the GETRIS (Geodesy and Time Reference in Space) mission, that aims to establish a geodetic reference station and precise time- and frequency reference in space by using optical two-way communication links between geostationary (GEO) and low Earth orbiting (LEO) satellites, a possible future gravity field mission can be set up. By expanding the GETRIS space segment to the global satellite navigation systems (GNSS) the optical two-way links also connect the GALILEO satellites among themselves and to LEO satellites. From these links between GALILEO and LEO satellites gravitational information can be extracted.

In our simulations inter-satellite links between GALILEO and LEO satellites are used to determine temporal changes in the Earth's gravitational field. One of the main goals of this work is to find a suitable constellation together with the best analysis method to reduce temporal aliasing errors. Concerning non-tidal aliasing, it could be shown that the co-estimation of short-period long-wavelength gravity field signals, the so-called Wiese approach, is a powerful method for aliasing reduction (Wiese et al. 2013). By means of a closed loop mission simulator using inter-satellite observations as acceleration differences along the line-of-sight, different mission scenarios for GALILEO-LEO inter-satellite links and different functional models like the Wiese approach are analysed.