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Temporal aliasing effects on future gravity satellite missions and their assessment – Lessons from the ESA-SC4MGV project

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Temporal aliasing is expected to add up to the error budget of future gravity satellite missions of low-low satellite-to-satellite tracking (LL-SST) type in such a way, that it could act as a constraining factor on their way to achieve the expected accuracy that new generation sensors could provide.

Within the scope of the ESA-SC4MGV project, we investigate the impact of temporal aliasing on future gravity satellite missions as well as methods for its minimization. This is achieved on the one hand by optimizing the choice for the orbital configuration, and on the other by optimizing the gravity field retrieval techniques accordingly. In this study we investigate the contribution of all error sources to the error budget and prove that temporal aliasing errors are one of the biggest contributors. We explore the advantages of using two in-line pairs in reducing temporal aliasing errors. For this purpose, the optimized orbit constellation consisting of two in-line pairs of a Bender type configuration is used as our “baseline” scenario.

Using the “baseline” scenario, we investigate gravity field processing methods that lead in a reduction of the temporal aliasing errors. As a first step we apply the so-called “Wiese” approach, which suggests co-estimating low resolution gravity fields at short time intervals in order to directly estimate the short-term signals that alias into the combined solution. We demonstrate the ability of the “Wiese” approach to minimize temporal aliasing errors for our “baseline” scenario. Moreover, we fine-tune the “Wiese” parameterization options such as the duration and the resolution of the gravity field solutions estimated at high frequency, in order to maximize the effectiveness of the method at reducing the temporal aliasing effects with respect to our chosen Bender constellation. As a step forward, we experiment with alternative parameterizations that combine low and medium spatial resolution gravity fields at different time intervals. The results for each parameterization are analyzed and the best set of parameterization is chosen for a 1-year full time variable gravity field processing. The “Wiese” parameterization results are then assessed and compared to the standard processing.