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Refinement of the acceleration approach for GRACE gravity field recovery

Matthias Weigelt, Tonie van Dam, and Zhao Li

Universitè du Luxembourg, Faculté des Sciences, de la Technologie et de la Communication, Luxembourg, Luxembourg (matthias.weigelt@uni.lu)

The GRACE mission yields monthly gravity field solutions with unprecedented quality. Nevertheless, the anticipated baseline precision has not been achieved to date. Various effects, e.g. the lack of precision in ocean tide models or aliasing effects, cause this degradation. Besides it is also important to minimize processing errors and repeatedly put assumptions in the approaches to test. Here, we investigate the acceleration approach which connects range accelerations and velocity differences to the gradient of the gravitational potential. Since the velocity differences can only be observed by GPS it resembles a limiting factor to the approach which can be mitigated by reducing the observation to a residual quantity. Assuming that the residual velocity difference can be neglected, the residual gradient of the gravitational potential is then approximately equal to the residual range acceleration. We reinvestigate this assumption and present a new way to handle the residual velocity difference term. The new approach is therefore a refinement of the existing approach but offers a better approximation to reality. This is especially important in view of the upcoming GRACE Follow-On mission which will be equipped with a laser ranging instrument offering a higher precision.