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The extended acceleration approach - an elegant way of constraining gravity field solutions from low-low satellite-to-satellite constellations

Matthias Weigelt, Balaji Devaraju, and Jürgen Müller
Leibniz Universität Hannover, Institute of Geodesy, Hannover, Germany (weigelt@ife.uni-hannover.de)

The concept of low-low satellite-to-satellite tracking missions allows for the observation of the temporal variations of the gravity field which was successfully implemented in the GRACE mission. Due to its orbit configuration the the satellites are orbiting the Earth nearly in North-South direction. As a consequence there is less senstivity to East-West features of the gravity field resulting in a weakend observability of the sectorial coefficients. This results in the so-called striping effect. This is, in general, inherent to any of the approaches used for gravity field recovery. The acceleration approach is one of them and connects range observables to the relative gradients of the gravity field projected on the line-of-sight between the satellite pair. But the acceleration approach in its most general description also connects range observables to projections of the relative gradients on the radial and the crosstrack direction. Generally, these equations are not used in everydays practice as the necessary quantities, such as the relative velocity vector, cannot be observed with a level of precision needed for the combination with the range quantities. However, linearization and considering the residual observation quantities as unknowns allows to make use of zero conditions. In other words, the gravity field is still determined by the line-of-sight component of the acceleration approach but now has to fullfile the zero conditions in the other two directions. These conditions therefore constrain a gravity field solution in an arguably very elegant way. We present the mathematical framework of the extended acceleration approach and discuss the benefits of the additional constraints on a gravity field solution using simulated and real data.