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A new variant of the acceleration approach for gravity field modeling from GRACE range measurements

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The KBR data acquired by the GRACE mission are provided in three different forms: as biased ranges, as range-rates, and as range-accelerations. The classical acceleration approach (Rummel, 1979) makes use of range-acceleration data. These data can be linearly connected with gravity field parameters and efficiently processed without costly computation of partial derivatives. However, inter-satellite velocity vectors have to be employed to make the connection complete. These vectors are typically determined from GPS data and may not be accurate enough for high-precision gravity field modeling.

A variant of the acceleration approach is proposed, where the functional model connects gravity field parameters with a linear combination of range measurements at three successive epochs without an explicit involvement of inter-satellite velocity vectors. Deriving this combination of ranges is approximately equivalent to a 3-point numerical differentiation. A high numerical efficiency of the approach can be reached by using the fast spherical harmonic synthesis and co-synthesis algorithms in combination with the pre-conditioned conjugate gradient scheme. The approach has been applied to computing the mean and monthly gravity field models from real GRACE data. The results are compared with those we obtained earlier with other techniques as well as with the models produced by other teams. It can be concluded that gravity field models produced with the proposed approach are comparable in quality or even more accurate than the alternative ones.