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# A least-squares technique for smoothing a satellite orbit in the context of gravity field modeling

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A new algorithm is developed to compute a smoothed and accurate satellite orbit on the basis of a kinematic orbit and a force model. Such a smoothed orbit is needed in the gravity field modeling procedure that is based on satellite accelerations. The procedure makes use of residual satellite accelerations defined as the difference between the observed accelerations and the reference ones. Computation of the reference accelerations requires an accurately determined set of satellite positions, which can be taken over from the smoothed orbit. The algorithm for computing the smmothed orbit is based on B-splines. A component of the orbit (i.e. a set of X-, Y-, or Z- coordinated in an inertial frame) is parameterized as a linear combination of B-spline functions with corresponding coefficients. These coefficients are determined by means of a least-square adjustment scheme. The force model is exploited to compute satellite accelerations, which are used as additional constraints. In order to find the balance between errors in the positions and unaccuracies of the computed accelerations, the generalized cross-validation technique is implemented. Thanks to the property of a local support of B-splines, the procedure is very fast.

A numerical example demostrates a performance of the proposed procedure. Furthermore, it shows that the solution with acceleration constraints is better than the solution based on the kinematic orbit only. The more precise the force model is, the more accurate smoothed orbit is obtained. Finally, a set of real CHAMP data is considered in the context of gravity field modeling. Smoothed orbits, which are computed both with and without acceleration constraints, as well as the original kinematic orbit are employed for calculating reference accelerations. The "Delft approach" is applied to recover gravity field models, which are compared with the EIGEN-CG01C model. The results show that usage of the smoothed orbit obviously improves the gravity field model,

especially if the smoothed orbit is computed with acceleration constraints.