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# Determination of a Gravity Field Model from one Month of CHAMP Satellite Data using Accelerations

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A gravity field model has been estimated based on reduced dynamic and kinematic state vectors of CHAMP. Newton Interpolation has been used to calculate accelerations and Least-Squares Collocation to estimate the spherical harmonic coefficients.

During data preprocessing positions and velocities of the reduced dynamic and kinematic state vectors are synchronized so that two corresponding data sets of one month (July 2002) with a sampling rate of 30s are achieved. Observations where the kinematic velocity is rejected due to edge effects or GPS observation discontinuities are deleted in both data sets.

A comparison of the two sets of state vectors shows that the majority of the differences in magnitude of position and velocity are in the range between $\pm$0.2m and $\pm$0.5mm/s respectively. Observations outside these boundaries are declared outliers and deleted. This reduces the data sets by approximately 0.7%.

Newton Interpolation approximates the velocity vectors which are transformed into an inertial system by a polynomial. Tests ascertain that the use of seven interpolation points achieves good results. The first derivative with respect to time of these polynomials gives the acceleration vector of each observation.

One-third of the reduced dynamic and kinematic observations have been utilized for the estimation of spherical harmonic coefficients. The Least-Squares Collocation is based on gravity disturbances derived from the magnitudes of accelerations. EGM96 up to a degree and order of 24 is used for the “remove-restore” method so that data become statistically more homogenised.

A comparison of the reduced dynamic and kinematic accelerations to those based on EGM96 up to a degree and order of 360 shows that the kinematic data are more influenced by noise than the reduced dynamic. The standard deviations of differences in accelerations calculated from EGM96 minus reduced dynamic or kinematic are 0.3mgal and 1mgal respectively.

These results are also reflected in the quality of the spherical harmonic coefficients. The standard deviations of differences in coefficients between EGM96 and reduced dynamic data are always lower than those between EGM96 and kinematic data.

Up to degree 60, both types of standard deviations are lower than the standard deviations of EGM96 coefficients themselves. The estimated gravity field model therefore provides information consistent with EGM96 up to degree 60. The model shows also an improvement with respect to coefficients which are derived by the energy conservation method utilizing the same data.