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Gravity Field Recovery from the Cartwheel Formation by the Semi-analytical Approach

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Past and current gravimetric satellite missions have contributed drastically to our knowledge of the Earth's gravity field. Nevertheless, several geoscience disciplines push for even higher requirements on accuracy, homogeneity and time- and space-resolution of the Earth's gravity field. Apart from better instruments or new observables, alternative satellite formations could improve the signal and error structure. With respect to other methods, one significant advantage of the semi-analytical approach is its effective pre-mission error assessment for gravity field missions.

The semi-analytical approach builds a linear analytical relationship between the Fourier spectrum of the observables and the spherical harmonic spectrum of the gravity field. The spectral link between observables and gravity field parameters is given by the transfer coefficients, which constitutes the observation model. In connection with a stochastic model, it can be used for pre-mission error assessment of gravity field mission.

The cartwheel formation is formed by two satellites on elliptic orbits in the same plane. The time dependent ranging will be considered in the transfer coefficients via convolution including the series expansion of the eccentricity functions. The transfer coefficients are applied to assess the error patterns, which are caused by different orientation of the cartwheel for range-rate and range acceleration. This work will present the isotropy and magnitude of the formal errors of the gravity field coefficients, for different orientations of the cartwheel.