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A analytical method to low-low satellite-to-satellite tracking (ll-SST) error analysis

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The conventional methods of error analysis for low-low satellite-to-satellite tracking (ll-SST) missions are mainly based on least-squares (LS) method, which addresses the whole effect of measurement errors and estimate the resolution of gravity field models mainly from a numerical point of view. A direct analytical expression between power spectral density of the ll-SST measurements and spherical harmonic coefficients of the Earth's gravity model is derived based on the relationship between temporal frequencies and sphere harmonics. In this study much effort has been put into the establishment of the observation equation, which derived from the linear perturbations theory and control theory, and the computation of the average power acceleration in the north direction with respect to a local north-oriented frame, which relates to the orthonormalization of derivatives of the Legendre functions. This method provides a physical insight into the relation between mission parameters, instrument parameters and gravity field parameters. In contrast, the least-squares method is mainly based on a mathematical viewpoint. The result explicitly expresses the relationship, which enables us to estimate the parameters of ll-SST missions quantitatively and directly, especially for analyzing the frequency characteristics of measurement noise. By taking advantage of the analytical expression, we discuss the effects of range, range-rate and non-conservative forces measurements errors on the gravity field recovery.