Development of the technique for covariance prediction using the gravity color noise

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Abstract

The conventional approach to estimation and prediction of orbits uncertainty is based on using the equations of motion, in which the random disturbances are either not taken into account, or assumed to be represented by white noise. In the first case, RMS of prediction errors occur to be underestimated. Attempts to represent this uncertainty by white noise have not yielded good results as well.

More realistic representation of covariance (RMS of prediction errors) can be achieved as a result of a number of improvements:

- The accounting for the noise during determination of orbits and at forecasting correlation matrices.
- Correction of the structure of data, which are saved in the catalogue after orbit determination of and then used for forecasting correlation matrices.
- Development of the technique for adaptive updating parameters of color noise based on the results of application of appropriate algorithms and programs.

The following questions are considered in the paper:

1. Bases of the technique for covariance prediction.

The analysis of the differential equations for forecasting a correlation matrix of state vector errors and their solution are executed. Is shown, that for maintenance of a correctness of results it is necessary to take into account mutual correlation of state vector errors with color noise. The technique for estimation of matrix function of mutual correlation during orbit determination is considered.

2. Statistical characteristics of gravity disturbing forces.

The problem on a choice of harmonics degree which is taken into account in motion model is considered. The dependence of the recommended degree on altitude and accuracy of constants Cnm and Snm is constructed. The estimation of correlation functions of gravity disturbing forces in the Body-fixed, and also in the Earth-centered inertial coordinate systems is presented. The correlation functions for the resonance satellites in the LEO and GEO, and also for the objects of GPS type are considered in detail.