**How can we increase the accuracy of determination of spacecraft's lifetime?**

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Abstract. In their content, the materials of this article represent continuation of some earlier published results of studies aimed at increasing the accuracy of determination and forecasting of the orbits of low satellites [1-7]. All these materials consider the application of the modification of the maximum likelihood technique called the technique of optimum filtering the measurements (OFM).

A feature of presented materials is the determination and forecasting of parameters of the "Tchibis" spacecraft (SC) orbit before the reentry instant over a rather long time interval (about 10 months). This makes it possible to more fully estimate the effect of atmospheric disturbances on the calculation results and to develop recommendations on increasing the accuracy of solution of the problem in question.

## 1. Introduction

The author published the principles of the applied procedure almost 40 years ago [8]. In the 70-ties this procedure was implemented at the Russian Space Surveillance Center for determining and forecasting the orbits of low satellites. Subsequently this procedure was updated. The characteristic feature of the procedure is accounting for statistical characteristics of atmospheric disturbances over the fit span and during the motion forecasting. The results of studying atmospheric disturbances were published in a number of articles, for example, in [8].

The autocorrelation function of atmospheric disturbances is assumed to be of the form

$$K_q(t,\tau)_0 = \begin{cases} \sigma_q^2\left(1-\frac{|t-\tau|}{\Delta}\right), & by \quad |t-\tau| < \Delta, \\ 0 \quad by \quad |t-\tau| \geq \Delta. \end{cases} \qquad (1)$$

The initial data for applying this correlation function are:

$\Delta T$ - the change of the period under an effect of atmospheric drag per revolution, which is calculated on the basis of numerical integration with the mean value of ballistic coefficient;

$k_{atm}$ - the RMS of random atmospheric disturbances with respect to their mean value;

$\Delta$ - the interval of correlation of atmospheric disturbances.

The first two quantities are used for calculating the RMS of atmospheric drag variations according to the formula

$$\sigma_q = k_{atm} \cdot |\Delta T|. \qquad (2)$$

The matrices of cross-correlation of errors in forecasting the state vector at time instants ($t_i$ and $t_l$) are calculated according to the formula

$$M\left[\delta x(t_i)\cdot \delta x^T(t_l)\right] = K_x(t_i,t_l) = U(t_i, \cdot t_k) \cdot K_x(t_k,t_k)\cdot U(t_l,t_k)^T + Q_{il}^{(k)}, \qquad (3)$$