UDC 519.25:681.5

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MODELS OF SPACE OBJECT MOTION BASED ON TIME SERIES OF TLE-ELEMENTS

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Timely detection of changes in the characteristics of space hardware objects during their long-term operation is one of the main tasks in the development and study of onboard systems that maintain the efficiency of their operation. This paper presents a statistical method for simulating the motion of space objects (spacecraft and used launch vehicle stages) in the class of autoregressive models. The method allows one to improve the quality of description and prediction of the motion of space objects based on simulating time series of their TLE-elements (two-line orbital element sets). The purpose of this work is to increase the accuracy of mathematical models of the observed motion of space objects in the problems of deorbit time determination, satellite collision prediction, and space debris cataloging. The paper presents a system for simulating the motion of space objects, which allows one to determine an optimal amount of learning samples in simulating time series of TLE elements, determine the order of autoregression and find an optimal model structure for each variable element, identify model parameters in conditions of unequally spaced observations, identify features of the time behavior of the root-mean-square errors of the constructed autoregressive models on the basis of dividing the initial time series of TLE-elements into successive learning intervals, and obtain predictive estimates of the values of variable elements. The proposed statistical method of space object motion simulation can be recommended to describe and predict the motion of spacecraft and used launch vehicle stages represented as time series of TLE-elements (which are publicly available and regularly updated). The application of the proposed statistical method will increase the accuracy of mathematical models of the observed motion of space objects in the problems of deorbit time determination, satellite collision prediction, and space debris cataloging.

***Keywords*:** time series of TLE elements, unequally spaced observations, autoregressive models, beta distribution, structural uncertainty, group method of data handling.

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Received on March 11, 2021,
in final form on April 5, 2021