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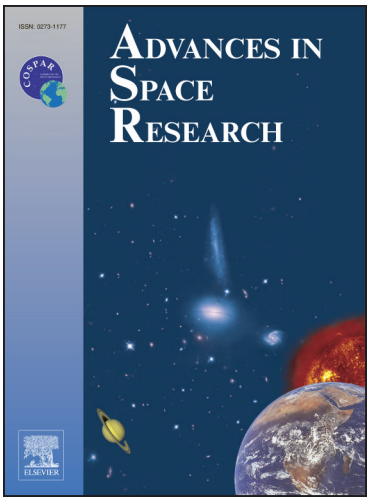


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# Motion Prediction of a Non-Cooperative Space Target

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**Abstract:** Capturing a non-cooperative space target is a tremendously challenging research topic. Effective acquisition of motion information of the space target is the premise to realize target capture. In this paper, motion prediction of a free-floating non-cooperative target in space is studied and a motion prediction algorithm is proposed. In order to predict the motion of the free-floating non-cooperative target, dynamic parameters of the target must be firstly identified (estimated), such as inertia, angular momentum and kinetic energy and so on; then the predicted motion of the target can be acquired by substituting these identified parameters into the Euler's equations of the target. Accurate prediction needs precise identification. This paper presents an effective method to identify these dynamic parameters of a free-floating non-cooperative target. This method is based on two steps, (1) the rough estimation of the parameters is computed using the motion observation data to the target, and (2) the best estimation of the parameters is found by an optimization method. In the optimization problem, the objective function is based on the difference between the observed and the predicted motion, and the interior-point method (IPM) is chosen as the optimization algorithm, which starts at the rough estimate obtained in the first step and finds a global minimum to the objective function with the guidance of objective function's gradient. So the speed of IPM searching for the global minimum is fast, and an accurate identification can be obtained in time. The numerical results show that the proposed motion prediction algorithm is able to predict the motion of the target.

**Keywords:** free-floating non-cooperative target; motion prediction; dynamic parameters identification; optimization

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