

POSE CHANGE DETERMINATION METHOD FOR AN ON-ORBIT SERVICE OBJECT WITH AN UNKNOWN SHAPE

*Institute of Technical Mechanics
of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine
15 Ieshko-Popel St., Dnipro 49005, Ukraine; e-mail: oafokov@ukr.net*

This paper presents a method for determining the pose of an on-orbit service object (target) with an unknown surface shape based on processing target surface point clouds. It is assumed that a point cloud is obtained using a sensor in the form of a lidar-based system onboard the service spacecraft. The algorithm of the method operates with a simplified description of the cloud; it uses only the coordinates of the cloud points without identifying any surface features. The idea of the method is as follows. From all cloud points obtained at a certain time instant, select points that are close to a certain degree to a given set of planes arranged in space in a certain way. From the point cloud corresponding to the next time instant, select points that are close to the same set of planes, but moved in space in a known way. By convention, let the arrangement of the projections of the selected cloud points onto the given planes be called a pattern of the intersection of the point clouds with the planes. By varying the displacement of the set of planes, maximize the coincidence of the intersection patterns of the first and second clouds of points. The degree of coincidence of the intersection patterns is characterized by a specified objective function whose arguments are target pose parameters. The target displacement parameters are found as the arguments of the objective function that maximize it. A variant of the objective function is proposed. A test example of the application of the proposed method is considered. A global optimization method known as the direct search method was used to find the arguments of the objective function. Test calculations were performed, and they confirmed the workability of the algorithm and determined its scope of applicability. The computational burden was not considered: the goal was to verify the workability of the method in principle. The advantage of the proposed method is its ability to determine a change in the pose of an object with an unknown surface shape. The proposed method may be considered as a source of observation data for a filtering procedure when estimating the parameters of the relative motion of a target with an unknown surface shape.

Keywords: *relative pose determination, on-orbit service, service object with an unknown shape, point clouds, objective function.*

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