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A NOVEL METHOD FOR UN-COOPERATIVE TARGET'S INERTIAL PROPERTIES
IDENTIFICATION BASED ON ANGULAR VELOCITY ONLY

Abstract

The space robot arms are normally employed to capture un-cooperative targets and execute Active Debris Removal(ADR) mission. The target's 10 parameters of inertial properties, including inertial tensor, mass center and mass, must be identified for the further operation after the target has been captured. Differing from the common identification methods which obey the momentum reservation/angular momentum reservation and use the measurements consisting of translational and rotational velocity, a novel method using angular velocity only is put forward in this paper.

The common identification methods have one severe fault. For the multi-bodies system that consists of the space robot platform, the arms and the unknown targets, the translational and rotational velocity of each body are required to be measured. However, the translational velocity, relative to the rotational velocity, sometimes may not be easy to be obtained. Then, it is worth to discuss a new method to identify the target's inertial properties without translational velocity information.

The detailed works are followed.

Firstly, to simplify the following model derivation, the whole system is divided into two parts. One is the robot system including the space robot platform and arms, another is the unknown target. It is obviously all the parameters of robot system are known.

Secondly, the whole system's inertial properties model, described by the inertial properties of space robot system and the target, is derived in the body frame of the robot system. The

Thirdly, the whole system's model obeying angular momentum reservation is reconstructed with the inertial properties of whole system. The unknown variables are the inertial properties of target and could be solved by the least square method. However, for the generally fixed shape system that the robot arms are locked and only the gyroscopes in the robot platform work, the equation is singularity and 10 inertial properties couldn't be solved.

Fourthly, singularity is eliminated by introducing the arms motion. Inspired by the work of Ou Ma, the robot arms capturing the target are supposed to move to construct the different shapes. The 10 inertial

properties of unknown target could be solved simultaneously with the angular velocity information from robot system and gyroscopes in the platform.

The primary simulation has proven the feasibility of the idea.

Keywords: Active Debris Removal (ADR), Un-Cooperative Target, Inertial Properties Identification, Angular Velocity Only