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DEVELOPMENT ACTIVE LOW-FREQUENCY MICROACCELERATION COMPENSATION SYSTEM BASED ON STEWART PLATFORM

Abstract

Constructing active low-frequency microacceleration compensation system of the entire satellite or for specific equipment on board is quite relevant problem at the moment. It is occurs due to necessity of provide residual level of microgravity vibration from μg to mg at the frequency range from 0.01 Hz to 100 Hz during a series of space experiments. The paper is devoted to the construction of an active vibration isolation system of experimental and technological equipment operating in microgravity conditions. To date the different types of active vibration isolation systems are constructed, but their characteristics and geometrical parameters do not always satisfy the given technological requirements. In this paper, Stewart platform is proposed for constructing microgravity active vibration isolation system, which provides protection against vibrations in six degrees of freedom and can be scaled depending on the specific tasks. The mechanism distinguishing feature is the presence of closed kinematic chain which provides high rigidity of the structure, reduce the mass of moving parts and reduce the load on the actuator. As a result, this increases the dynamics and positioning accuracy the movable part of the platform. The proposed version of microgravity vibration isolation system consists of two main parts: the electromechanical assembly and control unit. The main specifications for the constituent parts of the system are defined. A comparative analysis of different types of actuators and sensors for electromechanical assembly is carried out. The appropriate components to provide the desired specifications are selected. There are proposed to use piezoelectric motors as actuators in electromechanical assembly. Mathematical models of Stewart platform with six degrees of freedom and control system are considered. The structure of the control system and controller type is selected. A mathematical model of proposed microgravity vibration isolation system is developed and mathematical modeling of the system is carried out. The main characteristics of the system, demonstrating its performance in a given frequency range, are obtained. It should be noted that the area 10-100 Hz is the most complex for system operation. In this area the inertial characteristics of the system and speed of the drive mechanisms have the most heavily affect. It is proposed to use a combined system with passive and active elements. The design version of electromechanical assembly of microgravity vibration isolation system is presented. The general analysis of the resulting system, advantages and disadvantages of the system are given at the end of the paper.