MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Facilities and Operations of Microgravity Experiments (5)

Author: Mr. Wei Liu
Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences, China, lw20060846@aliyun.com

Dr. zongfeng li
Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences, China, lzfeng@csu.ac.cn
Dr. Wenbo Dong
Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences, China, wbdong@csu.ac.cn
Mr. Wenbin Wang
China, wangwenbin@csu.ac.cn
Mr. Chao Peng
Chinese Academy of Sciences, China, pengchao0109@mails.gucas.ac.cn
Dr. YANG GAO
Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences, China, gaoy386@yahoo.com

MODELING AND SIMULATION FOR MICROGRAVITY ACTIVE VIBRATION ISOLATION PLATFORM IN SPACE STATION

Abstract

Microgravity in orbit provides an important advantage for a wide range of research areas. However, the actual microgravity acceleration level of space station is not low enough for some scientific experiments. To overcome this deficiency, an active vibration isolation platform is usually required to offer a better microgravity environment. In this article, we would like to present our research on modeling and simulation for microgravity active vibration isolation platform in space station. The platform to be described consists of a stator and a floater. The stator is fixed on the space station, and the floater is suspended and only linked to the stator by umbilical cables. The floater's position relative to the stator is measured by a set of position-sense-detectors, and the acceleration is measured by accelerometers. Lorentz actuators are used to generate force and moment to control the motion of the floater so as to isolate the disturbance from the space station. Firstly, the linearized equations of the floater's motion relative to the stator are derived, and then the measurement models are also established to estimate the floater's acceleration level and its relative position and velocity with respect to the stator. Subsequently, a feedback control scheme is proposed, which includes an acceleration feedback loop and a relative position feedback loop. A Proportional-Integrate controller is designed in the acceleration feedback loop to reduce the floater's acceleration level, and a Proportional-Integrate-Differentiate controller in the relative position feedback loop is used to avoid collision between the floater and the stator. The control commands computed by the controller are realized by an optimal assignment of electric current of Lorentz actuators. Based on our modeling of a classical control system, simulations are finally performed considering model uncertainty, measurement errors, actuator output errors, and simulated disturbances. The simulation results showed that the attenuation of the floater's microgravity relative to the stator's was from -30 to -60dB under certain uncertainties and disturbances when the frequency of the stator's disturbance signal was from 0.5

to 20Hz. In general, this research work would be a useful guideline for designing and constructing an advanced microgravity active vibration isolation platform in the China's space station.