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A NEW CONCEPT OF FREE-FLOATING PLATFORM FOR MICROGRIVATY VIBRATION ISOLATION

Abstract

In order to provide the better microgravity environment for space science experiments, International Space Station and some other spacecrafts are equipped with active vibration isolation systems such as STABLE, ARIS, MIM, g-LIMIT, MVIS. China is also developing a MAVIS system recently. Those systems are reported to be able to alleviate the on-orbit vibration level to 10-5 to 10-3 g level at 0.1 100Hz. Here a novel strategy is proposed to improve the microgravity level, called the microgravity free-floating technology. Science experiment payloads are fixed in a platform which is able to float inside the spacecraft cabin, not affected by any on-orbit disturbances or vibrations, so it can achieve very good microgravity level. The platform is powered by chargeable batteries and equipped with controllable micro-thrusters to avoid collision with the cabin wall, so it can continuously work for several hours. This platform is made up with a spherical structure, electric ion thrusters, exchangeable batteries, high-accuracy accelerometers, position detection systems, signal sampling circuits and a central control module. Initially, the platform is placed on a docking room which provides the service of battery charging and data transmission. When running, the platform is released and free floats in the spacecraft cabin like a micro-satellite. When it moves slowly towards the wall due to uneven orbit or air flow, the control system automatically detects this little change by intelligent vision systems and generates an inverse force by the electric ion thruster. After batteries are exhausted, the platform is retrieved by astronauts and sent back to the docking room. We carefully simulate the fluid flow field in cabin and investigate the level of flow force and thruster forces on different shapes of floating objects. The simulation results show that it is feasible to control the total force to less than mN, which means the acceleration level of ug on a payload of 30kg. Such a suspended platform is expected to achieve the better microgravity environment (at least one order of magnitude than traditional vibration active isolation systems). Moreover, such a platform may be used as an in-cabin small satellite or as an assistant robot to help astronauts do many routine works. Although it can not work for too long time once, it is an innovative method to improve the microgravity enviornment with many good features. The space station technology with long-term astronaut participation induces the birth of this idea.