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ENHANCING THE ISOLATION PERFORMANCE OF HEXAPOD PLATFORMS VIA ALTERNATIVE LINK JOINTS AND ELECTROMAGNETIC SHUNT DAMPERS

Abstract

Managing low-level mechanical disturbances on spacecraft, typically in the range of 1 Hz to 1 kHz, is a principal design constraint for missions requiring extreme stability. Example of payloads concerned include optical instruments, space interferometers and laser communications equipment. Hexapod platforms represent a primary candidate for an architecture that can provide the necessary isolation performance with a minimal number of links and built-in redundancy. However, the mass and complexity imposed by actively-controlled devices largely offset their favourable characteristics and hinder their practical adoption. A potential solution is the integration of recently developed semi-active damper struts, for instance ones based on electromagnetic shunt dampers (EMSD). While avoiding control algorithms, such a design still requires a further challenge, mechanical in nature, to be addressed. In particular, the traditional rotational connections between the links, mobile and base platforms pose an inherent limitation of mid- to high-frequency isolation. It can be shown that the issue is rooted in rotational inertia effects of the struts. To that end, this paper proposes a pin-slider alternative to the usual pin-pin link boundary condition. Practical implementation of the slider is facilitated by the substitution of rotational joints, such as spherical or universal, with a novel planar joint. An optimised link topology is also demonstrated, so that total moving mass is brought to a minimum and struts undergo almost purely linear motion, thereby exhibiting attenuation performance closer to idealised theoretical models. The design and construction of a hexapod platform incorporating both the EMSD struts and the new type of planar joint connection is

outlined. Experimental results are shown alongside finite element analysis data for the complete system, clearly indicating the benefits of the proposed design.