Conceptual Study of 6 DOF Precision Control of Payload Using 6 Axis Hybrid Actuator

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For a class of satellites, very tight pointing accuracy, such as sub-micro radian pointing stability, is often required. Typical examples are astronomical satellites that observe celestial bodies using large telescopes with long focal length and optical communications satellites that receive and transmit high throughput data from/to other satellites or ground stations using narrow beam laser. In order to achieve such tight pointing requirement, however, conventional attitude control system (ACS) is insufficient or even impotent mainly because the control bandwidth is limited and the pointing error is unobsevable and/or uncontrolable. Therefore, a popular approach to cope with the problem is to furnish a payload pointing control system (PCS) typically using a fast steering mirror, combined with a vibration isolation system (VIS) between disturbance sources and the payload. In this configuration, ACS and PCS cooperatively play a role of coarse and fine control of the payload, respectively, within their own control bandwidth. VIS takes care of the frequency region higher than the conrol bandwidth of PCS.

In this presentation, an alternative approach that utilizes 6 DOF(degree of freedom) precision control of payload using 6 axis actuator, instead of PCS and VIS, is pursued. This system provides the function of both payload pointing control and vibration isolation. Moreover, the system decouples the PCS function from the ACS. And the VIS function takes care of the whole frequency region.

A general view of the concept is first presented, and then the fundamental characteristics of the system compared to those of conventional PCS plus VIS system are studied. The use of hybrid actuator is referred to with its unique feature compared to a fully active actuator. The control framework and schemes that are essential to realize the system are also discussed.

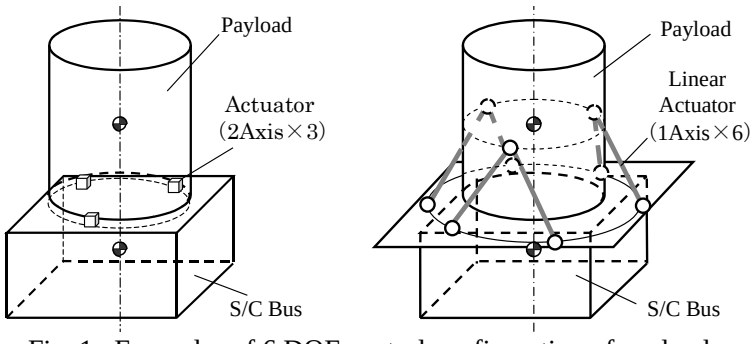

Fig. 1. Examples of 6 DOF control configuration of payload

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