Paper ID: 28313
oral
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Smart Materials and Adaptive Structures (5)

Author: Mr. Seong-Cheol Kwon
Chosun University, Korea, Republic of

Ms. Su-Hyeon Jeon
Chosun University, Korea, Republic of
Prof.Dr. Hyun-Ung Oh
Chosun University, Korea, Republic of

PSEUDOELASTIC SMA MESH WASHER GEAR WITH MICRO-JITTER ATTENUATION CAPABILITY FOR STEPPER ACTUATED MECHANISM

Abstract

A stepper actuated mechanism such as two-axis gimbal type X-band antenna used to transmit real-time image data from the satellite to the ground station is one of the main micro-jitter sources. The micro-jitter disturbances induced by the stepper motor activation may seriously affect the image quality of the high resolution observation satellite. Therefore, attenuating micro-jitter from a jitter sources is important task to enhance image quality of the observation satellite. In the previous study, Kozilek et al. proposed a spring-blade design with a low rotational stiffness on the existing external spur gear wheel to attenuate the micro-jitter in the azimuth directional rotating movement of the antenna. This design approach provided a reliable technical solution that can be easily implemented without making major modifications on the antenna design. The effectiveness of the micro-jitter attenuation by using the spring-blade gear was verified through the micro-jitter measurement tests of the stepper actuated antenna. However, if an unexpected over driving torque is induced to the spring-blade gear by somewhat reasons such as alignment shift of the gear axis due to an excessive launch loads applied to the gear wheel under launch environment or thermal deformation of the gear under on-orbit environments, it might induce plastic deformation on the spring-blade gear; then this causes a critical factor that leads to serious mission failure. This problem can be easily solved by increasing the rotational stiffness of the spring-blade to guarantee the structural safety of the gear itself. However, this approach may results in another problem that micro-jitter attenuation capability cannot be expected anymore. To overcome aforementioned drawbacks, we focused on the use of a shape memory alloy (SMA) mesh washer, that exhibits pseudoelastic behaviour, as a substitute for the conventional spring-blade gear. This SMA washer can be deformed considerably without being plastically deformed under excessive loading condition and it can recover its original shape upon unloading after a large deformation. This application makes it possible to achieve a relatively much lower rotational stiffness and damping than the conventional gear. Therefore, the SMA mesh washer gear exhibits significant micro-jitter attenuation capability without being plastically deformed under much higher loading conditions. To measure the basic characteristics of the SMA mesh washer gear in rotational direction, static test were performed. The effectiveness of the micro-jitter attenuation capability of the SMA mesh washer gear was demonstrated through the jitter measurement tests using the X-band antenna actuated by the stepper motor.