

## Development of precision measurement table for the disturbance of satellite actuator

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### ABSTRACT

Rotating wheel type satellite actuator generates unwanted disturbance forces and torques. Six DOF measurement table for disturbances of satellite actuator is developed and a test reaction wheel for a small satellite STSAT3-class is also manufactured as test actuator. Disturbance data is post-processed for waterfall graphs and the disturbance model parameter is finally obtained.

### INTRODUCTION

Momentum exchange type actuators, such as reaction wheel and control moment gyro generate the torque required for satellite attitude control. However, their torque generation performance is deteriorated by the unwanted disturbance forces and torques due to their wheel rotation, axis misalignment and imbalance etc. A mathematical model of such disturbances is so necessary for precision attitude analysis and control.<sup>1,2</sup> The model is obtained by mathematical analysis and proved by experiments. Measurement table is needed to take experimental data for disturbance.<sup>3</sup>

### DISTURBANCE MEASUREMENT TABLE

Spacecraft Control Lab in Korea Aerospace University have developed a 6D measurement table as shown in Fig.1 for measuring the force and torque disturbances of satellite actuator. Reaction wheels for a small satellite STSAT3-class are also manufactured as test actuators shown in Fig.2. The measurement table is equipped with a platform supported by four 3-axis force load cells(DACELL) and a data acquisition and analysis computer system. The vibration of DACEL loadcell structure is analyzed for indentifying the table natural frequency.

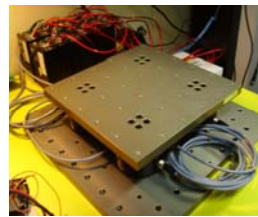


Fig.1 Measurement Table



Fig.2 KAU Reaction Wheel

The raw disturbance experimental data is post-processed in batch job and disturbance waterfall graphs are obtained as shown in Figs.3 and 4. The peak values shown in the graphs are extracted in order to get the parameter of wheel disturbance model.

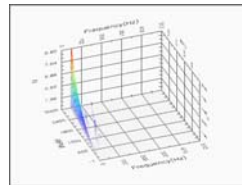


Fig.3 X disturbance force

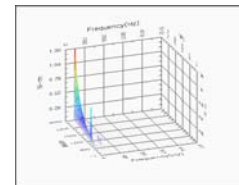


Fig.4 X Disturbance Torque

### CONCLUSIONS

Reaction wheel disturbances have been measured and identified successfully by the developed table.

### REFERENCES

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- 2.Bosgra, J.A., and Prins, J.J.M., 1982, "Testing and Investigations of Reaction Wheels," *IFAC Automatic Control in Space*, The Netherlands.
- 3.Oh, H.-S., Kwon,J.-W., Lee,H., Nam,M.-R., Park, D.J., 2001, "Torque and Force Measurement of a Prototype HAU Reaction Wheel and the Effect of Disturbance on the Attitude Stability of Spacecraft," *KSME Int. Journal*, Vol.15,No.6,