Experimental Study on Line-of-Sight (LOS) Attitude Control Using Control Moment Gyros under Micro-Gravity Environment

Hirohisa Kojima,[1*] Kana Hiraiwa,[1] YasuhiroYoshimura,[1] and Koki Hidaka[1]
[1]*Tokyo Metropolitan University, Japan*
hkojima@tmu.ac.jp

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Control moment gyros (CMGs) are attitude control actuator systems. An advantage of CMGs systems is that they can generate a larger control torques by tiling the gimbal axis of the control moment wheels than reaction wheel (RW) systems. However, because CMG system has many movable parts such as gimbals and wheels, thus CMG systems have a higher risk of being broken, compared to reaction wheels (RW) systems. Even if one or several CMGs are broken, it is highly demanded for satellites to continue the attitude control as much as possible because it is impossible to repair the broken CMGs after launching satellites.

In our previous study [1], line-of-sight (LOS) attitude control using two-single gimbal CMG was studied numerically, assuming that two CMGs are broken. In [1], attitude control process was divided into two phases; feedforward control and feedback control phases, and the WZ parameters are used to express the satellite model attitude, because the WZ parameter expression is suitable for two-axis (LOS) control.

In this paper, we will report experimental results of LOS attitude feedback control using two-single gimbal CMGs under the micro-gravity environment generated by parabolic flight. Figure 1 shows the experimental setup of satellite model equipped with the CMGs system for this study. Arduino-MEGA is used as an on-board computer to send the angular velocity of the model and receive the gimbal rate command calculated by a note PC via blue tooth.

The time history of WZ parameters, obtained by the experiments, is shown in Fig. 2. As shown in Fig. 2, as the result of the gimbal control of two-CMGs, LOS represented by w1 and w2 has a tendency of approaching zero. Consequently, the validity of the proposed LOS attitude control using two-single gimbal CMGs based on the WZ parameters is experimentally confirmed.

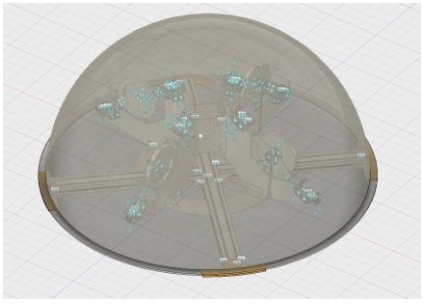

Fig. 1. CMG experimental setup.

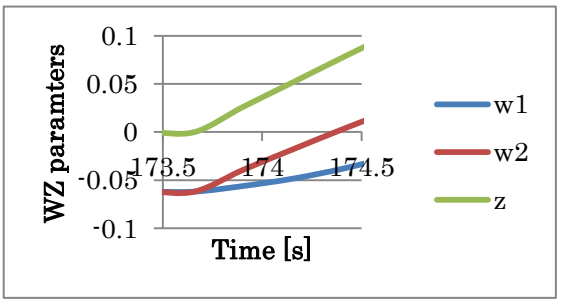

Fig. 2. Experimental time history of WZ parameters.

References

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