IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

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PW-SAT2 DEORBIT SAIL TEST CAMPAIGN AT DROP TOWER AND VERIFICATION ON ORBIT

Abstract

Deorbit system for PW-Sat2 satellite designed as a square sail (2m side) stretched across four flat springs, coiled around a specially shaped centre pivot. Sail deployment system requires less than 2 W of power for less than 1 minute to initiate the deployment. The deployment of the sail is driven completely by the energy stored in folded flat C-shaped springs, that release and unfold the structure of the sail. Therefore, the deployment process is very dynamic, lasts less than 0.7 s and strongly varies depending on environmental factors like gravity, friction of surfaces or moment of inertia of the mechanism. Due to the large sail dimensions and the way it deploys, the gravity influence on the sail deployment is significant while testing on the ground. The team had verified various concepts for testing the system, nevertheless gravitational forces acting on all parts of the sail cause adverse effects. Moreover, is it difficult to observe the influence of the dynamic sail deployment on the satellite structure itself. Around 25 exact sail models have been built for testing purpose on the ground, but none of these tests provided a sufficient microgravity

imitation.

The PW-Sat2 team has been qualified to DropTES Program organized by ZARM in collaboration with UNOOSA and DLR. The test of 4 sails deployment in the microgravity conditions under low pressure during the free-fall in Drop Tower had been performed. To get reliable results, a real size dummy mass model of the satellite was prepared. Due to the large size of the sail, the experiment had to be dropped from the height of 8 meters in the Drop Tower deceleration chamber. This resulted in about 1.2 s of free-fall.

The experiment successfully conducted in November 2017 proved the reliability of the PW-Sat2 sail's deployment system. Moreover, the readouts of accelerometers mounted on satellite's model and footage gathered during the experiment series allowed to fully understand the influence of the sail deployment process on the satellite. The satellite had been successfully launched on board of Falcon 9 at SSO-A mission on 3rd December 2018. The satellite deployed the deorbit sail on 29th December. On-board cameras sent dozens of valuable images confirming the full deployment. The dynamics of the satellite had been registered by gyroscopes. The on-orbit deployment can be compared to the drop tower test.