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THE EXO-BRAKE AS A DE-ORBIT MECHANISM: ANALYSIS AND RECENT FLIGHT  
EXPERIENCE THROUGH SOAREX AND TECHEDSAT FLIGHT TESTS

**Abstract**

The Exo-Brake is an exo-atmosphere braking device to permit the rapid de-orbit of an object/satellite in Low Earth Orbit (LEO). It was originally conceived as a safer means of assisting in de-orbiting small sample canisters from the International Space Station (ISS). Specifically, more traditional propulsive means of performing the de-orbit maneuver – such as cold-gas or hot-gas (rocket motor) would face significant safety challenges as the device would have to be processed either inside or in close-proximity of the ISS. The Exo-Brake also does not require attitude stabilization as the aerodynamic torque exerted by the aft-mounted device fixes the de-orbiting system directly on the path of the flight velocity vector. Recently acquired flight data with TechEdSat-3 and -4 using a sub-scale Exo-Brake mounted to 3U nano-satellites is presented. Techniques for further control and improved targeting using timing, drag-modulation, and other means are described. These techniques will be advanced in TechEdSat-5 (to be jettisoned from the ISS in 2016) and TechEdSat-6. Lastly, future work leading to routine payload sample return from orbital platforms is outlined (SPQR – Small Payload Quick Return) and compared to other concepts.