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**DRAG DE-ORBIT DEVICE: A NEW STANDARD RE-ENTRY ACTUATOR  
FOR CUBESATS**

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**ABSTRACT**

With the advent of CubeSats, research in Low Earth Orbit (LEO) becomes possible for universities and small research groups. Only a handful of launch sites can be used, due to geographical and political restrictions. As a result, common orbits in LEO are becoming crowded due to the additional launches made possible by low-cost access to space. CubeSat design principles require a maximum of a 25-year orbital lifetime in an effort to reduce the total number of spacecraft in orbit at any time. Additionally, since debris may survive re-entry, it is ideal to de-orbit spacecraft over unpopulated areas to prevent casualties.

The Drag Deorbit Device (D3) is a self-contained targeted re-entry subsystem intended for CubeSats. By varying the cross-wind area, the atmospheric drag can be varied in such a way as to produce desired maneuvers. The D3 is intended to be used to remove spacecraft from orbit to reach a desired target interface point. Additionally, attitude stabilization is performed by the D3 prior to deployment and can replace a traditional ADACS on many missions.

This paper presents the hardware used in the D3 and operation details. Four stepper-driven, repeatedly retractable booms are used to modify the cross-wind area of the D3 and attached spacecraft. Five magnetorquers (solenoids) over three axes are used to damp rotational velocity. This system is expected to be used to improve mission flexibility and allow additional launches by reducing the orbital lifetime of spacecraft.

The D3 can be used to effect a re-entry to any target interface point, with the orbital inclination limiting the maximum latitude. In the chance that the main spacecraft fails, a timer will automatically deploy the booms fully, ensuring the spacecraft will at the minimum reenter the atmosphere in the minimum possible time, although not necessarily at the desired target interface point. Although this does not reduce the risk of casualties, the 25-year lifetime limit is still respected, allowing a reduction of the risk associated with a hardware failure.