SPACE DEBRIS SYMPOSIUM (A6)
Mitigation and Standards (4)

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DEORBITSAIL: FLIGHT-TESTING A DEORBITING SYSTEM

Abstract

Purpose Deorbitsail (www.deorbitsail.com) is a Seventh Framework Program (FP7) mission to demonstrate drag deorbiting via deployable sail. Unlike NASA's Nanosail-D, Deorbitsail will fly with a complete communications bus and three-axis attitude control.

Large sails have been proposed (and used) for long-distance space journeys, stationkeeping, and certain orbital manoeuvres. In these applications, solar sailing takes advantage of low forces applied over a long time to effect changes. Sails for deorbiting are dual-mode: at high altitudes, solar radiation pressure is the dominant force, and at lower altitudes, atmospheric drag overpowers SRP. Deorbitsail is a demonstrator: its purpose is to raise the technology readiness level of a deployable sail system. The Deorbitsail team hopes that an increase in TRL will make this low-mass, low-energy deployable sail an attractive deorbiting subsystem for future spacecraft, and therefore mitigate the problem of space debris.

Methodology Similar to Nanosail-D (NASA), Lightsail-1 (Planetary Society), and CubeSail (Surrey Space Centre), Deorbitsail works with the 3U CubeSat standard and uses four deployable booms to unfurl four triangular sail segments. These segments will form a 5-by-5-metre square, which will be used for drag deorbiting. Three-axis attitude control will keep Deorbitsail pointed in the direction that maximizes drag. Depending on orientation, the stowed Deorbitsail CubeSat will have a frontal area of between 0.01 and 0.07 m^2. With the sail deployed, the area will increase to slightly less than 25 m^2.

Results and conclusions Working within the restriction of the ISIPOD standard 3U CubeSat deployer, the present design for Deorbitsail divides the length of the spacecraft into three approximately equal zones for electronics, sail storage, and boom deployment. The deployable boom system has performed well in environmental tests and the chassis and electrical subsystems are entering production.

Further notes The Deorbitsail team consists of nine international partners. The Surrey Space Centre (United Kingdom) is coordinating the project, with Innovative Solutions in Space (Netherlands) providing AIT and launch coordination and Surrey Satellite Technology, Ltd. (United Kingdom) providing ground support for the flight phase. The deployable booms have been designed by DLR (Germany), the sail membrane scheme by EADS Astrium SAS (France), and the attitude determination and control system by Stellenbosch University (South Africa). Athena SPU (Greece) will coordinate the software and primary

electronics. The University of Patras (Greece) has designed the custom nanosatellite chassis, and Middle East Technical University (Turkey) has produced a study of schemes for vibration damping.