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SPACE PROPULSION SYMPOSIUM (C4)
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Author: Mr. Andrew Wolahan
Cranfield University, The Netherlands, andrew.wolahan@esa.int

TRIANGULAR DEPLOYABLE SPACE SAIL FOLD PATTERNS AND SAIL MATERIALS

Abstract

Space sails have been proven to provide both propulsion in space, and drag in the upper Earths atmosphere to deorbit a satellite at the end of its life. They require no fuel once deployed, provide a substantial decrease in storage space and weight, while also minimising the design impact the propulsion system has on the spacecraft, along with a substantial savings in costs.

However, a sail requires a large area in order to provide substantial changes in the speed (both acceleration and deacceleration) of a spacecraft. This is where the folding patterns become an issue with sails. For instance, if the sail is rolled up, it changes the characteristics of the sail, or if it is folded over itself several times, the material will stretch and therefore wear over time. So it is important to identify a triangular fold pattern which will fold down to as small a point as possible. As from triangular sails, we can design the shape of any sail required.

Having started my research in November 2011, I began by identifying all possible fold patterns which may be used for triangular sails. All possibilities such as the 'zig zag accordion', pleat, Muira-Ori, Penrose and many more. Having adapted two fold patterns I recently identfied two possible ways of folding the space sail down to tiny percentage in area compared with the fully deployed version.

I am currently writing a computer program which will provide the print out template of the fold pattern for any given size triangle. After this, the deployability of the fold pattern will be tested on relevant software.

Once this is completed, then the analyse will begin on several possible materials for the space sail, such as Kapton, Mylar, CP1(clear polymide) along with several others.

After this, using the best suited material, the triangular fold pattern will be printed out onto a sheet and the fold demonstrated.

Finally, in a few months, the production of a prototype will commence. This will also include the design of the central hub, and sail booms which will hold the sails taught in space.

The prototype will undergo several tests to ensure deployment, (which will include an analysis of how taught the sail will be), vibration, (to simulate that of the launch of a spacecraft), analysis of the drag or acceleration it will provide for the given weight of an spacecraft, to name but a few.