Technology Transfer Office

Licensing Opportunity

Morphing Space lattices: Deployable structures for space applications, including solar arrays, antennas, or other similar systems

Overview

The volumetric capacity of the launch vehicle is a major constraint on the design of a spacecraft, and consequentially every system on board the launch vehicle needs to be as space efficient as possible. This includes solar arrays and antennas, which are typically packaged with a deployment structure to stow in a compact package but also reliably deploy to a great length. The weight of the launch vehicle is another critical design parameter because of the thrust power needed during the launch.

Thus, when considering the design of deployable structures for space, as well as structural stiffness the packaging ratio and mass are important. The packaging ratio determines the relative length change of the structure, from the stowed to the deployed configuration. The mass of the structure is important due to high launch costs, and sufficient stiffness is required to resist load on the structure from an AOCS (attitude & orbit control system) of the associated orbiter. In addition, deployment of the structure must be reliable and controlled, to prevent damage to attached components.

Deployable space structures generally use Collapsible Tube Masts (CTM) and Storable Tubular Extendable Members (STEM). These are tube structures that can be flattened and rolled for storage and can also deploy to great lengths. However, CTM and STEM usually require relatively large mechanisms to control the speed and direction of deployment. Scaling up known deployable space structures and achieving suitable geometry in the deployed configuration also present engineering challenges.

This technology enables deployable structures which perform well in all of the above-mentioned design aspects, and address the above-mentioned or related shortcomings and other problems in this field.

Technology

Advanced composite materials enable the development of lightweight and stiff deployable structures that have significant potential for the space sector. A morphing lattice is a structure composed of clockwise and anticlockwise strips of carbon fiber-reinforced plastic. This technology utilises a morphing lattice as the structural member and deployment mechanism for deployable space structures, whether for space booms, solar arrays, or antennae. This technology enables the use of morphing lattices by providing for:

1. The nesting of lattices within one another in a manner that enables telescopic deployment, increasing the packing efficiency.
2. The use of a tension element to control the deployment of the lattices, to prevent damaging vibrations.
3. The arrangement of the lattice strips is such that it can deploy on a curved path.

Benefits

This technology is ideal for deployable space components by improving on the following design aspects:

Low Packaging ratio: By combining multiple lattices and stowing them inside of each other, a very low packaging ratio can be achieved. The lattice can be in its stowed configuration during launch, only to deploy to great lengths when required.

Lightweight: The lattice is composed of narrow strips of carbon fiber-reinforced plastic, making it very lightweight. Additionally, as the structure is self-deploying, no heavy deployment mechanism is required. Reducing the weight of the lattice makes it cheaper to launch the device into space.

Bending stiffness: The bending stiffness of the structure can be tailored to suit the application, by changing the lay-up of the strip.

Deployment to any shape: The structure can be tailored to deploy to different lengths and radii depending on the application. Deployment structures using CTM and STEM can only deploy in a straight line, whereas the morphing lattice has a unique capacity to deploy in both a straight line and curves. When curved and straight lattices are combined in series they can theoretically deploy to any shape.

Applications

This technology is ideal for deployable space components due to the volume and weight restrictions of space flight. However, the qualities of this technology make it suitable and useful in applications where the structure needs to be adaptable while remaining lightweight and rigid. Other such applications could include use in super-cars, high-performance sailing boats, and aircraft.

Commercial Opportunity

The University of Limerick is seeking partners to exploit the commercial potential of these technologies by entering into licensing agreements.

☐Development partner

☐Commercial partner

☒Licensing

☒University spin-out

☐Seeking investment

Patent Filings:

EPO:

- "Deployable Structures", Publication WO2021037785A1
- "Deployable Structures", Publication WO2021037786A1
- "Deployable Structures", Publication WO2021037787A1

US:

- "Deployable Structures", Patent Application:17/753,029
- "Deployable Structures", Patent Application:17/753,027

China:

- "Deployable Structures", Patent Application: 2020800605510
- "Deployable Structures", Patent Application: 2020800605563

Journal publications:

https://www.sciencedirect.com/science/article/pii/S1359836820334909

https://www.sciencedirect.com/science/article/pii/S0263822321010394

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Figures

Figure 1: Three lattices with different stability point locations

Figure 2 Morphing lattice with a curved deployment path