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Manufacturing of 3D-printed morphing origami solar sails for the next generation of CubeSats

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The project team and timeframe

The feasibility study team comprises of Dr Stefania Soldini (Principal) and Dr Paolo Paoletti (Co) Investigators from the University of Liverpool, working in partnership with Dr Juan Reveles (Origami Deployable Structures) from Oxford Space Systems, in Oxford, and Dr Stephane Bonardi (Robotics), Dr Naoya Ozaki (CubeSat Design), Dr Ahmed Sugihara (Solar Sails) and Prof Osamu Mori (Solar Sails) from the Japan Aerospace Exploration Agency (JAXA) in Japan. The project is expected to begin in September 2020 and to be completed by March 2021. To learn more, watch the YouTube video project overview at the following link or via QR code.

<https://www.youtube.com/watch?v=U5lhFlxZxZI>



What does the project demonstrate?

The project is exploring Additive Manufacturing (AM) to prototype a new morphing origami solar sail mechanism for next generation of self-reconfigurable CubeSats. A solar sail is an origami thin, lightweight highly reflective membrane capable of harnessing the effect of the Sun radiation pressure. It enables fuel-free propulsion by reflecting the intensity of the sunlight. This project will demonstrate the feasibility of a new generation of origami solar sail's membrane that, by changing its local surface reflectivity, will trigger shape reconfiguration for multi operational CubeSats.

Origami Self-Reconfigurable CubeSats

Currently, spacecraft deployable structures (i.e. solar arrays, antennas, etc.) are deployed in-space utilizing origami-based designs. However, all such large devices are designed to maintain a fixed-shape once deployed and a single spacecraft usually mounts multiple structures for different purposes.

The project aims at transforming the approach to space exploration missions from a single spacecraft towards a bio-inspired swarm of self-reconfigurable CubeSats that can coordinate and adapt to different situations like "ant colonies".



Next Generation of Solar Sails

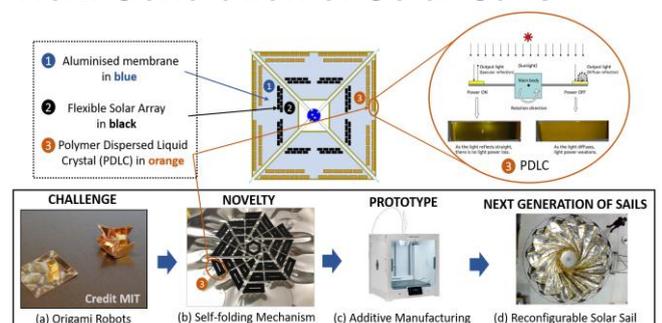


Figure 1 – Example of 3D-printed sail: (a) MIT's self-folding origami robot, (b) New Solar Sail's mechanism with embedded PDLC devices for harnessing solar radiation pressure to trigger the self-reconfiguration of CubeSats, (c) Additive Manufacturing for prototyping and (d) Next Generation of Solar sails.