

Satellite Applications

SME Case Study

Oxford Space Systems

Bringing to market a new
generation of deployable
structures for Space

Image: ©ESA-P. Carril, 2013

We work with
Innovate UK

CATAPULT

The Company

Company Name	Oxford Space Systems
Managing Director	Mike Lawton
No. of Employees	10
Launched	September 2013
Location	Harwell, Oxfordshire
Sector	Space Hardware

www.oxfordspacesystems.com

T: +44 (0) 1235 567 999

E: explore@oxfordspacesystems.com

Part of a new wave of small, agile businesses transforming the Space sector.

Combines traditional and new, proprietary materials to reduce stowage volume, complexity and cost.

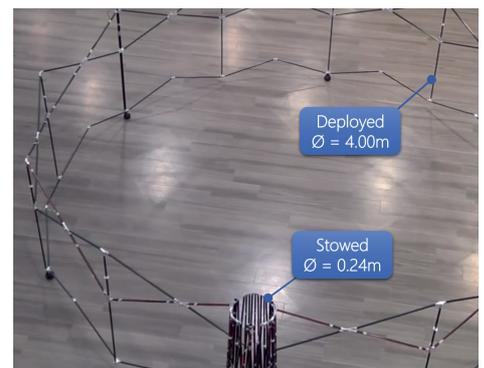
Overview

Oxford Space Systems (OSS) is bringing to market a new generation of deployable structures for Space that are lighter, less complex and lower cost than existing products. Part of a new wave of small, agile businesses transforming the Space sector, it is unusual in its focus on satellite hardware – historically an expensive sector for small firms to break into. OSS is attracting interest from leading satellite manufacturers in Europe and the US because of its use of innovative materials and agile approach to product development.

- Challenging traditional design concepts of deployable structures for Space by developing a novel range of telescopic boom systems, large deployable antennas and deployable panel designs.
- Combining traditional and new, proprietary materials, such as flexible composites, to reduce stowage volume, complexity and cost.

Novel Hardware for Space

Booms, antennas and panels are essential for most satellites but they add complexity and weight, and take up precious space on a launcher, with inevitable implications for cost. At Oxford Space Systems, innovator Mike Lawton, together with an industry experienced team including Professor Zhong You, an expert in origami and structural engineering at Oxford University's Department of Engineering, are successfully tackling these challenges following their initial success in developing a novel, compact unfolding parabolic antenna.



Scalable large deployable antenna

Their focus on new designs and materials for deployable structures was validated when OSS won £100,000 in matched funding for further research and development in the Harwell Space Launchpad competition in 2013. This, in turn, triggered seed investment from venture capital fund Longwall Ventures, allowing Lawton to strengthen the fledgling OSS team by bringing in world-renowned space mechanisms engineer Martin Humphries.

Replacing Boom Mechanics with Memory

Current boom structures – extendable arms that unfold from satellites to position solar



A novel solution using a strong, lightweight 'shape memory' material that unfurls from a rolled-up state in a controlled manner.

OSS brings fresh thinking, new materials and an ability for fast-paced development.

panels, antennas or payloads – are complex, with many moving parts. They also need their own dedicated power system. In contrast, one of OSS's innovative designs relies on the 'memory' properties of its own proprietary composite material which unfurls to assume a rigid final shape, just like a plant leaf on a stem. This reduces complexity and, compellingly, weight and cost.

OSS's innovation was to orientate space grade carbon fibre weave – which is usually deployed for its rigidity and strength – in a novel way and combine this with resins tolerant to the space environment. The result is a strong, lightweight, 'shape memory' material that unfurls from a rolled-up state in a controlled manner to its planned functioning flight configuration. This is the basis of the AstroTube™ boom for microsat and cubesat applications. "We have designed this technology to deploy a wide range of instruments from satellites," explains Mike. "It is scalable up to 3m and very adjustable."

OSS has also designed a telescopic boom – the AstroTube Max – that is scalable up to 10m for mid to high mass payload deployments. It has just finished qualification testing of a 2.5m long boom under the Harwell Launchpad initiative and is now working with both Airbus Defence & Space and Thales Alenia Space (UK) to further develop its boom designs.



AstroTube Max Scalable Boom

Novel Deployable Antennas

Deployable antennas are another focus for OSS. Satellites use antennas for capturing and relaying signals. They are critical for communication satellites and increasingly required for Earth observation and data relay satellites – essentially forming an 'Internet in Space'.

To address potential problems with large deployable antennas (LDAs) that can be caused by high levels of vibration during take-off and extreme temperature gradients, OSS has developed an entirely new solution. "We're not forced to evolve legacy designs, building upon those that have gone before," explains Mike. "OSS brings fresh thinking, new materials and an ability for fast-paced development."

The team has a 4m diameter prototype which is scalable up to 12m and is developing a novel shape memory surface to act as the reflector surface. This further reduces the complexity of the antenna as well permitting operation at the higher frequencies demanded by telecomms operators. The antenna and its surface can connect to an OSS boom system enabling the company to offer a complete LDA assembly.

The OSS team is also exploring applying origami techniques to deployable systems for solar panel structures – the power source for all satellites – applying the same design philosophy evident in its booms and antenna technology: simplify and reduce mass to increase reliability and utility while cutting costs and production lead-times.

The Future

OSS is now expanding its team in order to develop its product portfolio, and has just raised £1.2 million in a new funding round led by existing seed investor Longwall Ventures.

The company is working under contract with LuxSpace on deployable antenna designs for global ship tracking and with Airbus Defence & Space on novel deployable panel concepts. It has also been selected by the UK Space Agency to fly its AstroTube Boom in a 3U cubesat mission in 2016 and has received an order for its cubesat boom technology from Kazakhstan (see case study).

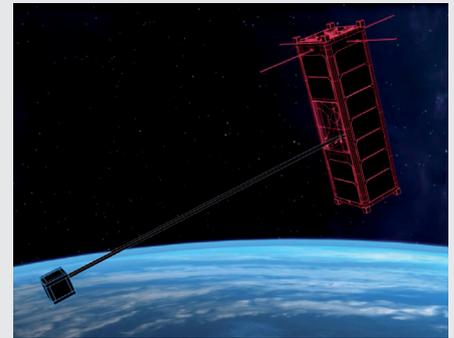
Mike has a clear vision for developing the company. "We offer a way of outsourcing innovation, working with conventional and next generation materials, with the aim of lowering the cost and reducing lead times of Space hardware. With our culture of minimising bureaucracy and relatively low overheads, we're in a strong position to move boldly and be first to market – and crucially we're in the right support environment at Harwell to achieve our ambition."

“The Catapult offers a unique innovation environment for our business to succeed.”

Case Study:

Record-Breaking Boom Offers Hope of Earthquake Warnings

Cubesats have many advantages but their size can impose limitations, such as the size of booms, which are usually small articulated arms limited to the length of the satellite. OSS's proprietary, flexible material is allowing it to remove this restriction and is now under contract to deliver the longest deployable boom ever to be launched on a cubesat to Kazakhstan's Institute of Space Technique and Technologies (ISTT).



Cubesat boom

The AstroTube boom will unfold from a tiny unit on board the 30x10x10cm cubesat to a fully extended length of 1.5m. The boom is gently deployed via a motor, thus avoiding any destabilising shock to the cubesat that can be caused by spring-based systems and also uniquely permits it to be restowed if required.

The much longer boom allows different experiments to be carried out by these tiny satellites. In this case the ISTT cubesat is due to be launched late in 2016 with the boom carrying a tiny magnetometer that will measure the strength of the Earth's magnetic field. This is a pathfinder mission to determine whether, as some evidence show, this field fluctuates measurably just before earthquakes and therefore whether a constellation of cubesats could provide an early warning system for such events. “It's unlikely that a system will be 100% accurate,” notes Mike. “But this is a very interesting mission and shows how novel technologies could one day allow us to have earthquake warnings with an accuracy similar to weather forecasts.”

Catapult Support

The Satellite Applications Catapult has been involved with Mike and the OSS team since its inception and this relationship was enhanced by OSS's Launchpad win in 2013. Commenting on Launchpad, which is run by Innovate UK and the Science & Technology Facilities Council, Lawton says: “Launchpad is designed to support projects considered too risky to take forward without initial funding or those breaking into new areas of research, so it was perfect for us. We gained investment and it also led to a new relationship with the Catapult, helping to expand our network and raise our profile.”

The following spring, OSS participated in one of the Catapult's Business Sprints, focusing in particular on investment readiness. “The Catapult team was knowledgeable and helpful, and brought original thinking which led to a quality output that I was able to use at high profile events,” notes Lawton.

Since then the Catapult has continued to support OSS. For example in April 2015, OSS attended the UK-Singapore Showcase event organised by the Catapult. “The Catapult offers a unique innovation environment for our business to succeed. It has hosted numerous deployments of our LDAs, which has helped secure contracts with Airbus D&S and the UK Space Agency,” says Lawton.

“There's a buzz of innovation at Harwell and being here gives us a level of gravitas within the Space industry, together with access to contacts and invaluable resources. It's hard to think of a more perfect innovation environment in the UK, or indeed Europe, right now for our business to succeed.”

Electron Building
Fermi Avenue
Harwell Oxford
Didcot
Oxfordshire
OX11 0QR

For more information:

T: +44 (0) 1235 567999
W: sa.catapult.org.uk
E: info@sa.catapult.org.uk
@SatAppsCatapult