



The Development of a Low Mass Extendible Composite Boom for Small Satellite Applications

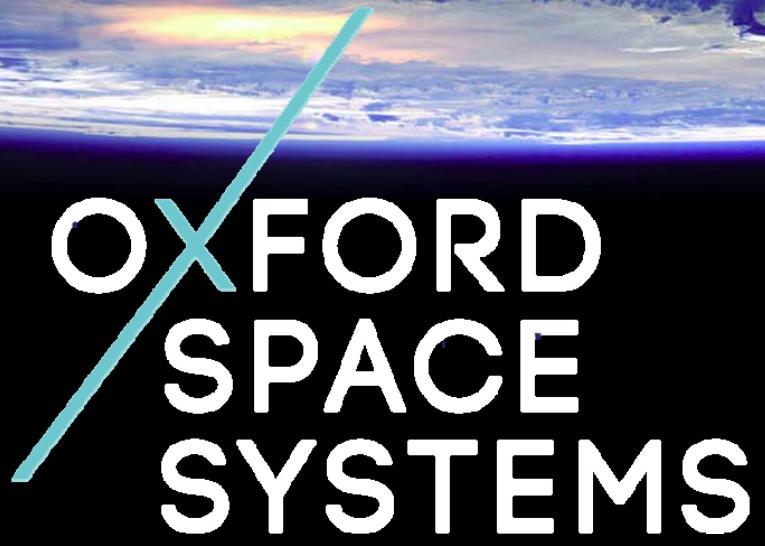
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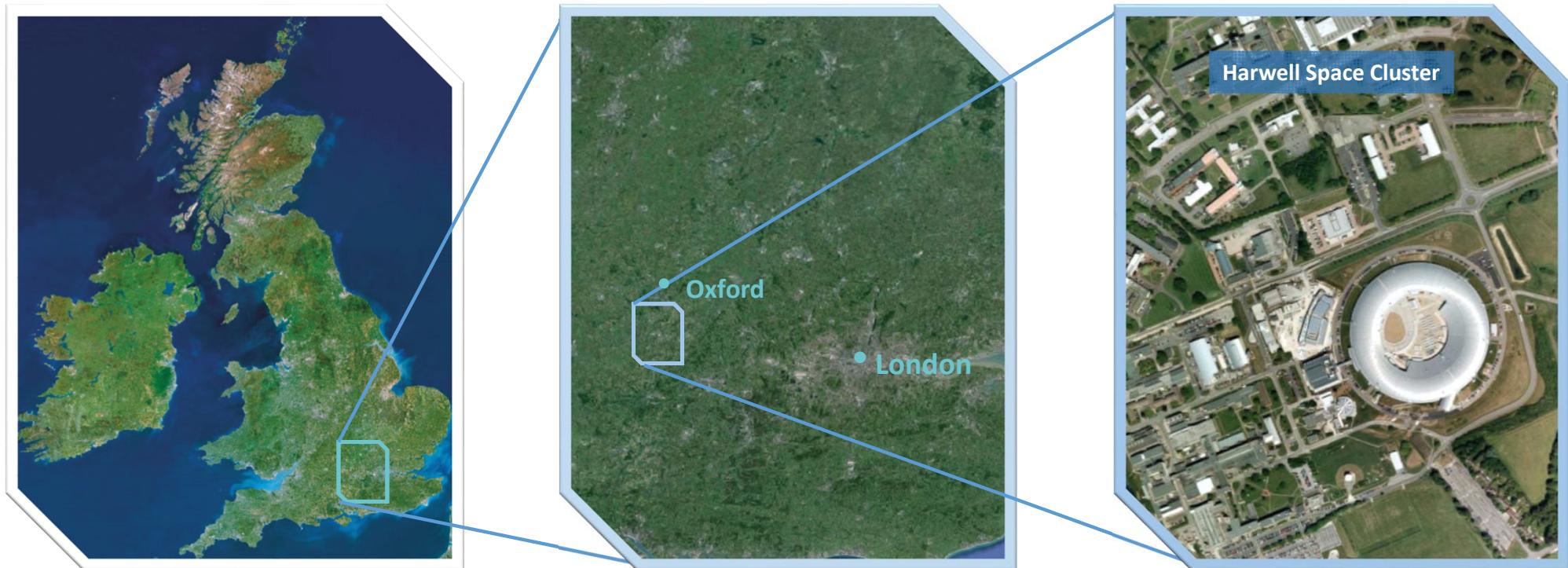
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An **award-winning** space technology business **pioneering** the development of a new generation of **deployable space structures** that are **lighter**, less complex and **lower cost** than those in current commercial demand.

Where We Are

Located within the **UK's biggest space technology cluster** at the Harwell Campus



Who We Are



Mike Lawton
Founder & CEO

- 2x successful entrepreneur
- Entrepreneur of Year Award
- IMechE Design of Year Award



Dr. Juan Reveles
Technical Director

- 15 years of complex systems experience: automotive & space
- Award-winning PhD research



Prof. Zhong You (PhD. MS BS)
Key Collaborator

- Origami expert
- Associate Professor of Engineering Science
- Expert in closed kinematic chain structures



RAL Space

MDA

Science & Technology Facilities Council

Innovate UK
Technology Strategy Board

CATAPULT
Satellite Applications



Matthew Dreaper
Finance Director

- Key role, in £93m worth of transactions over the last decade
- £2m of funding for a number of start up ventures since 2008



Martin Humphries
Key Collaborator

- ESA recognised expert in space mechanisms
- Ex Head of Mechanisms at BAE Systems
- 25+ years space flight design, 40+ successful flight missions



John Yates
Non-Exec Board Director

- 29 years experience in commercial space
- UK Delegate to the European Space Agency
- Policy Advisor to the UK Parliamentary Space Committee



Dr Alex Brinkmeyer
Knowledge Transfer
Partnership Associate

- PhD in Morphing Composite Structures
- MEng in Aeronautical Engineering
- 5 journal & conference publications

Collaborators & customers

AIRBUS
DEFENCE & SPACE

LUXSPACE

ThalesAlenia
Space
A Thales / Finmeccanica Company

axon'

MDA

RAL Space

Science & Technology Facilities Council

Innovate UK
Technology Strategy Board

CATAPULT
Satellite Applications

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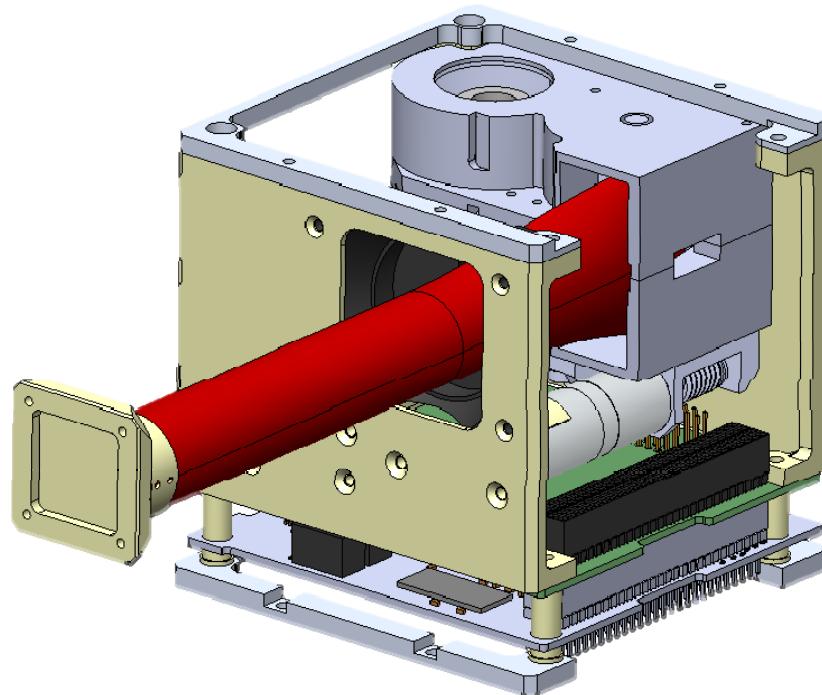
Extendible Composite Boom

Features

- Length: 2 meters
- Deployment accuracy <1mm
- Retractable (full or partial)
- Deployment accuracy <1mm
- Stowage efficient (<0.5U)
- I²C controlled

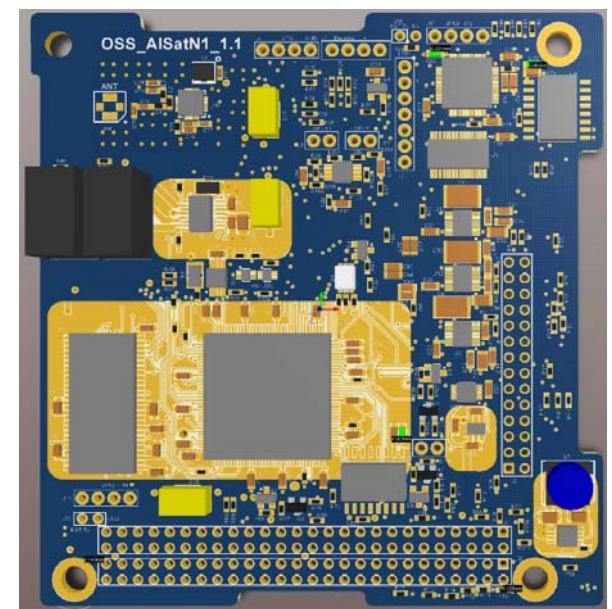
Applications

- Payload deployment
 - Magnetometers
 - Camera systems
- Antenna Systems
- Actuator element



Control Electronics

- Two PCBs
 - Main controller PCB: MCU-1: STM32F429 (180MHz)
 - 64 MB NAND flash; 8 MB SD RAM
 - 3 X 20-bit ADCs (1 MSPS max) – magnetometer data capture
 - Variable clock speed for FFTs, data compression etc
 - Sub-payload PCB: MCU-2: STM32L151 (32MHz)
- Power consumption:
 - 900 mW (max)
 - 50 mW (low power mode)
 - 5 mW (sleep mode)
- Comms I/F: I²C

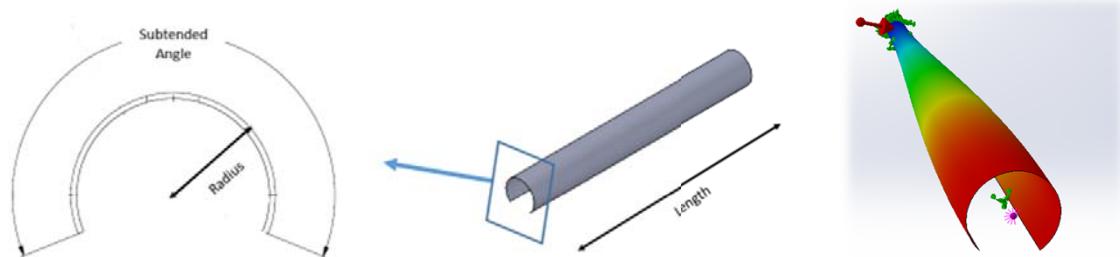
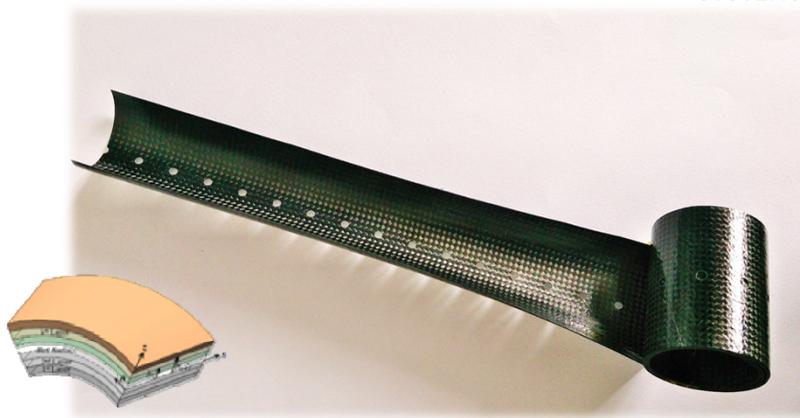




Flexible Composite Tube

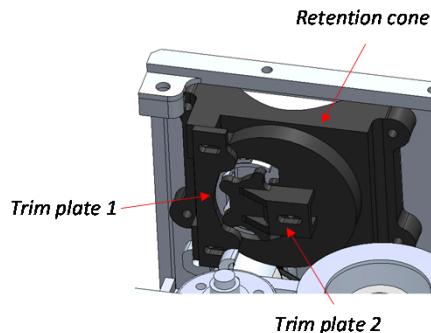
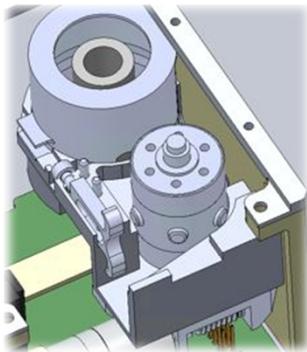
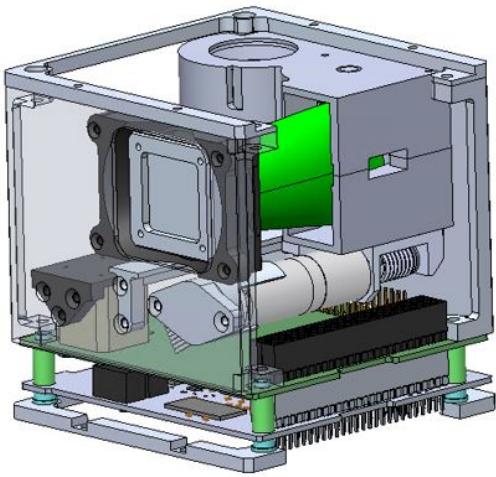
Extendible Element:

- Epoxy-based plain weave (PW) fibre
 - ✓ Low out-gassing
 - ✓ Good radiation tolerance
- 0.3mm thickness
- Open section - 20 mm diameter
- 224° subtended angle





Mechanical Design



Construction

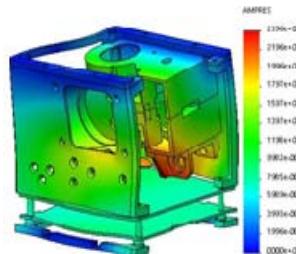
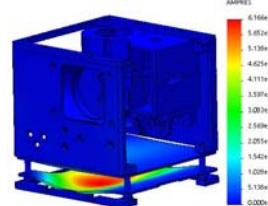
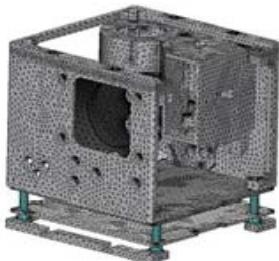
- Mechanical parts: alocromed aluminium alloy 6061T6 / European equivalent 6082T6
- Low friction interfaces: Delrin-acetal
- Delrin bracket to support magnetometer
- Aluminium bracket to support motor assembly
- Trim plates ensure perpendicular deployment to XY plane



Analysis

Dynamic Analysis & Modelling

- Modal finite element analysis undertaken to establish dynamic characteristics of structure
- Model details: 170,199 solid tetrahedral elements with 93.4% above acceptable aspect ratio.
- Total nodes: 291,449; DOF: 877,179
- Analysis run for first 45 modes; resultant frequency range 278Hz to 2,496Hz
- First structural mode at 377Hz (z-axis / 52% mass participation)
- Random base excitation (GSFC standard): results indicate that all components within material limits



Conclusions & Next Steps

- Breadboard performed as designed
- Analysis results good – two EQMs built
- Qualification of EQM by end of August 2015
- In orbit demonstration on 3U UK Space agency platform AlSat-N1 mission: Q3, 2016
- Commercial flight: Q4, 2016



TRL6 AstroTube™ Max mechanism

Thank you for your attention.

Mike Lawton

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