Satellite Applications

Fact Sheet

TechDemoSat

The UK's national satellite to test and prove the next generation of space hardware in orbit

We work with Innovate UK

CATAPULT

CATAPULT
Satellite Applications

TechDemoSat is one of the UK's national satellites, launched in July 2014.

Overview

TechDemoSat is one of the UK's national satellites that was launched in July 2014 to demonstrate, test and prove the next generation of space hardware in orbit. It carries eight payloads from UK academia and industry which will run until the scheduled end of the mission in July 2017.

The aim is to provide successful demonstrations of the payloads in operational conditions, making it easier for industry and research partners to win technology contracts. TechDemoSat (TDS) is also being used by Surrey Satellite Technology Ltd (SSTL) to test and prove new satellite technology.

How the Catapult is Involved

Spacecraft and mission operations for TechDemoSat are being managed by SSTL and the Satellite Applications Catapult, respectively.

The launch and early operations phase (LEOP) was performed by SSTL from the Catapult's Operations Centre at Harwell. SSTL now runs the spacecraft operations centre from its Guildford base.

Catapult Operations Centre at Harwell

The Catapult team supported the in-orbit commissioning phase and since then we have been responsible for ensuring that payload operations run smoothly on the satellite, as well as long-term data archiving. This phase started in October 2014 following a 3-month payload testing period.

The payloads run in rotation across an 8-day cycle, with two or three running in tandem at a time. The Catapult takes the weekly requests from the payload operators and ensures there are no conflicts before uploading them to SSTL.

Mission planning software allows the Catapult team to check and balance a number of attributes for each new set of planned activities for each payload. This include aspects such as power requirements, because the combined draw on the satellite's battery must not exceed predetermined limits, both to avoid draining the battery and to prevent the satellite from getting too hot.

Our team also ensures that if any payload activity requires a change in the satellite's attitude, this will not affect any other payloads that are active during the same period.

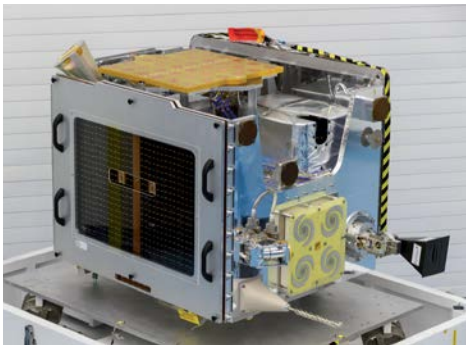
The Catapult is responsible for ensuring that payload operations run smoothly, as well as long-term data archiving.

The Satellite

TechDemoSat is a modified version of SSTL's heritage satellite platform SSTL-150, which was developed for the RapidEye mission.

Changes include:

- an enhanced on-board computer, which provides greater ability to conduct software experiments remotely
- a new battery charge regulator
- newly qualified cell types on two of the solar panels
- a smaller tank size for the propulsion system, alongside a new high performance thruster (Hollow Cathode Thruster)
- new sun sensors in the altitude and orbital control system.



TechDemoSat

TechDemoSat carries eight payloads, making four ‘suites’: Maritime, Space Environment, Air and Land Monitoring, and Platform Technology.

The propulsion system was tested earlier than expected when the satellite had to react to ‘close approach warnings’ (a collision alert) twice in August 2014.

The Payloads

Following great interest in providing payloads for the satellite, eight payloads were eventually chosen for the mission. These make up four ‘suites’: Maritime, Space Environment, Air and Land Monitoring, and Platform Technology. The technology payloads have been actively operating since October 2014.

Maritime

There is one payload in the Maritime Suite: SSTL’s Sea State Payload (SSP). This uses GPS signals to measure sea state.

The Sea State Payload Altimeter is an active radar altimeter based on technology for the NovaSAR-S spacecraft that was developed by Airbus Defence and Space. It is based on an improved version of a technique known as global navigation satellite systems reflectometry (GNSS-R), which was first demonstrated in 2004 by SSTL and the National Oceanography Centre, in this case using reflected global positioning satellite (GPS) signals.

The synthetic aperture radar (SAR) antenna pulses S-Band frequency radar waves onto the ocean and the weak echo waveforms that are detected can provide valuable data on the state of the ocean, such as significant wave height measurements, sea surface height and wind speed. This type of sea state data can be used in meteorology, oceanography, climate science and ice monitoring. It could be particularly useful for commercial shipping, for example, by letting them plot better routes to avoid severe sea conditions, and may also have applications in soil moisture monitoring.

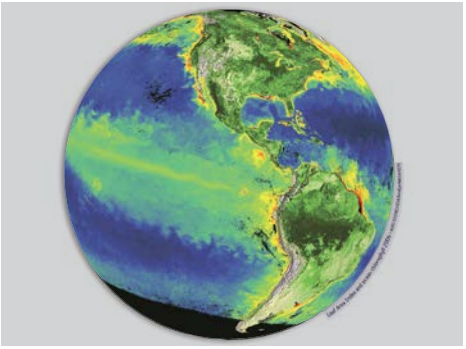
The SSP payload has already proven successful, with results published for ocean surface wind speeds up to more than 60 miles/hour.

The Sea State Payload uses GPS signals to measure sea state, with potential applications in meteorology, oceanography, climate science and ice monitoring.

Space Environment

Four payloads make up the Space Environment Suite:

- MuREM – Surrey Space Centre
- Charged Particle Spectrometer (ChaPS) – Mullard Space Science Laboratory (MSSL)
- Highly Miniaturised Radiation Monitor (HMRM) – Rutherford Appleton Laboratory and Imperial College
- Langton Ultimate Cosmic ray Intensity Detector (LUCID) – The Langton Star Centre, which is part of the Sixth Form at Simon Langton Grammar School, supported by SSTL, University of Houston, NASA and STFC.



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Monitoring our oceans

MuREM is a miniature radiation environment and effects monitor that can act as a radiation alarm and diagnostic package and is being tested to prove its ability to provide security for future missions.

ChaPS is designed to detect electrons and ions using a compact instrument, which will be useful on missions where space and power are limited, such as in space weather constellations.

HMRM is a small, lightweight radiation monitor designed to measure total radiation dose and particle flux rate, and identify particle species that has been designed to provide spacecraft operators with data to correlate with subsystems performance, alerts of extreme flux levels and system diagnostics.

Finally, LUCID is the result of a UK Space Agency competition to design a payload for the satellite and give students experience of taking part in authentic research. This new style of

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A year into its mission, TechDemoSat has proven that this is a successful way to deliver this type of platform for compact payloads.

cosmic ray detector checks space weather, characterising the energy, type, intensity and directionality of high energy particles using sensor technology developed at CERN. One of its targets is to take measurements when travelling through the South Atlantic Anomaly – a region in which many other satellite payloads might be adversely affected by the higher than average levels of particle activity.

Air and Land Monitoring

This suite comprises the Compact Modular Sounder (CMS) from Oxford University's Planetary Group and Rutherford Appleton Laboratory, which is a low-cost, modular, infrared, remote sensing radiometer unit.

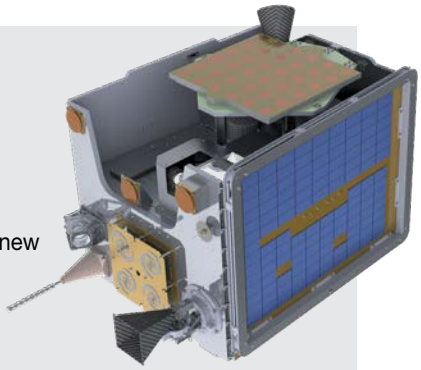
Platform Technology

The Platform Technology suite has two payloads: the CubeSAT ACS attitude determination and control subsystem from SSBV; and a 'de-orbit sail' designed by Cranfield University. The latter will only be tested at the end of the mission when it is deployed to safely bring the satellite back into the Earth's atmosphere to burn up.

Satellite Facts

Satellite:	TechDemoSat
Size:	1 metre cubed*
Weight:	150kg*
Payloads:	Eight; plus SSTL heritage and new product development systems
Launch date:	8 July 2014
Launch vehicle:	Soyuz 2-1B (Russian)
Funders:	Innovate UK, South East England Development Agency, SSTL
Spacecraft operations:	Surrey Satellite Technology Ltd
Mission operations:	Satellite Applications Catapult

** Approximate measurements*



Future Activities

The aim was for TechDemoSat to be the first of a series of UK technology satellites that will provide an affordable means for companies and academia to demonstrate, test and prove the next generation of space hardware in orbit. Even though it is not yet halfway through its mission, it has proven that this is a successful way to deliver this type of platform for compact payloads.

References:

Foti, G. et al.; Spaceborne GNSS reflectometry for ocean winds: First results from the UK TechDemoSat-1 mission; July 2015; Geophys. Res. Lett., 42, 5435–5441, doi:10.1002/2015GL064204.

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