Government backs UK companies tackling dangerous ‘space junk’

- Currently there are approximately 160 million objects in orbit – mainly debris – which could collide with satellites vital to services we use every day

- UK Space Agency and Ministry of Defence sign formal agreement to work together on monitoring threats and hazards in orbit

Seven pioneering projects which will develop new sensor technology or artificial intelligence to monitor hazardous space debris, have been announced today by the UK Space Agency.

The UK Space Agency and Ministry of Defence have also announced the next step in their joint initiative to enhance the UK’s awareness of events in space.

Estimates of the amount of space debris in orbit vary, from around 900,000 pieces of space junk larger than 1cm to over 160 million orbital objects in total. Only a fraction of this debris can currently be tracked and avoided by working satellites. The UK has a significant opportunity to benefit from the new age of satellite megaconstellations – vast networks made up of hundreds or even thousands of spacecraft – so it is more important than ever to effectively track this debris.

Today’s investments will help bolster the UK’s capabilities to track this space junk and monitor the risks of potentially dangerous collisions with satellites or even the crewed International Space Station.

Projects backed today include Lift Me Off who will develop and test machine learning algorithms to distinguish between satellites and space debris, and Fujitsu who are combining machine learning and quantum inspired processing to improve mission planning to remove debris.

Two companies, Deimos and Northern Space and Security, will develop new optical sensors to track space objects from the UK whilst Andor, based in Northern Ireland, will enhance their astronomy camera to track and map ever smaller sized debris.

D-Orbit UK

D-Orbit UK will use a space-based sensor on their recently launched satellite platform to capture images of space objects and couple this with Passive Bistatic radar techniques developed by the University of Strathclyde.

Finally, new satellite laser ranging technologies will be researched by Lumi

Space to precisely track smaller space objects.

Last year there was a close call in which a £100 million spacecraft operated by the European Space Agency (ESA) had to light up its thrusters to dodge a satellite. A clash between the spacecraft was far from certain, but the trajectories posed enough of a threat that ESA concluded that they need to manoeuvre the spacecraft out of harm's way.

Business Secretary Alok Sharma said:

> Millions of pieces of space junk orbiting the earth present a significant threat to UK satellite systems which provide the vital services that we all take for granted – from mobile communications to weather forecasting.
>
> By developing new AI and sensor technology, the seven pioneering space projects we are backing today will significantly strengthen the UK's capabilities to monitor these hazardous space objects, helping to create new jobs and protect the services we rely on in our everyday lives.

Graham Turnock, Chief Executive of the UK Space Agency said:

> People probably do not realise just how cluttered space is. You would never let a car drive down a motorway full of broken glass and wreckages, and yet this is what satellites and the space station have to navigate every day in their orbital lanes.
>
> In this new age of space megaconstellations the UK has an unmissable opportunity to lead the way in monitoring and tackling this space junk. This funding will help us grasp this opportunity and in doing so create sought after expertise and new high skill jobs across the country.

The funding coincides with the signing of a partnership agreement between the Ministry of Defence and UK Space Agency to work together on space domain awareness. This civil and military collaboration aims to bring together data and analysis from defence, civil and commercial space users to better understand what is happening in orbit to ensure the safety and security of UK licensed satellites.

Building on the UK's current efforts, which has seen the UK Space Agency and RAF analysts working together since 2016, this agreement will further improve our space domain awareness capabilities.

It could also provide opportunities to work alongside global allies, such as the US, to support our continued work to enhance space sustainability and maintain the UK space industry as a global leader.

The UK is already a world-leader in small satellite technology, telecommunications, robotics and Earth observation, and our universities host some of the best minds in the world for space science. Space surveillance and tracking (SST) is a growing international market which space consultants Euroconsult and London Economics forecast could potentially reach over £100 million.

ENDS

Projects in detail

Note: Confirmation of projects led by Andor and Lumi Space are still subject to final agreement

Lumi Space

Lumi Space are working on photonic technologies for ranging and characterisation of space objects, from satellites down to space debris. Satellite laser ranging is an ideal method for precise tracking of space objects, and innovations developed by Lumi enable high-performance, low-cost systems to do this. This project is for continuation of Lumi R&D.

Deimos

This project focuses on the design, prototyping and demonstration of a Low-Cost LEO Optical Surveillance Sensor. The core work is an integrated processing board to conduct all necessary image calibration and data extraction operations used as a standalone or multiple-aperture "multiple-eye" design. A '40×40 squared degrees one-eye' prototype will be built together with the software systems to control and process the images and will be demonstrated during an observation campaign. In the final solution, ''9 eyes'' will be combined.

Lift Me Off

The project is concerned with developing machine learning algorithms for in-orbit detection and classification of satellites and space debris using a combination of space-based sensors and artificial intelligence. The technology will be able to distinguish between satellites operating nominally and anomalously together with understanding the composition of space debris on-orbit. A prototype test bed with representative sensors, electronics and algorithms will be built to experimentally develop the concept and techniques which can be later scaled up to an end-to-end autonomous algorithm for detection of anomalous behaviour that can, similarly to air traffic control, raise warnings based on live information.

D-Orbit

D-Orbit UK will exploit a new capability to enable routine, targeted space-based LEO SST observations using D-Orbit's ION Satellite Carrier Vessel, a platform with a multi-year lifetime and propulsion capability, to offer an unprecedented opportunity to observe debris both passively and actively. ION star trackers will be repurposed to capture images of space objects for

processing on board and on ground, coupled with Passive Bistatic radar techniques developed by the University of Strathclyde, which uses third party illuminators to characterise resident space objects. NORSS will process, associate, integrate and support the commercialisation of the data within wider SST services.

Fujitsu

Fujitsu, in conjunction with its partners, Astroscale, the University of Glasgow and Amazon Web Services (AWS), are undertaking a project to develop a proof of value to make space debris removal missions more commercially viable using its open innovation methodology. It will be evaluating how to optimise trajectory planning for multi-debris removal missions. Fujitsu is bringing together its ground-breaking quantum inspired optimisation services, which benchmark studies prove are up to 10,000 times faster than traditional computers, along with a 40 year heritage in space in Japan. In combination with Astroscale's space debris removal expertise, the University of Glasgow's space research capabilities and AWS Cloud and Machine Learning services, the project will support the UK's ambition to grow its share of the global space market to 10% by 2030.

The project involves the industrial research to rapidly design and deploy an extremely low-cost prototype optical camera system to track objects in Low Earth Orbit. Designed from the ground up, the sensor will be competitive with radar observations for providing both UK independent space surveillance and tracking data and characterisation data of objects. The project is split into 6 phases and once deployed the camera will perform a live observation campaign acquiring positional and photometry data on space objects culminating with a validation exercise against a real-world experimental debris removal mission operated by Astroscale.

Andor

Detection of Low Earth Orbit debris of smaller sizes is of increasing importance due to the ongoing increases in quantities of both Satellites and potentially satellite destroying in-orbit debris. Traditional CCD cameras have a significant (40 second) read out 'dead time' which considerably limits their application in detection of small in-orbit debris. The proposed project is intended to make significant improvements to Andor's Balor very large area (17 megapixel / 70mm diagonal) scientific CMOS camera. Balor is ideal for large sky surveys that measure photometric and astrometric variability across timescales ranging from milliseconds to tens of seconds. The proposed project will significantly increase Balor's sensitivity resulting in considerably faster imaging and/or enabling the tracking of smaller in-orbit debris.

A report by Dr Mark Hilborne (King's Space Security Research Group) and Dr Mark Presley (MAP Analytica), called Towards a UK space surveillance policy, has been published by the King's Policy Institute. It positions a UK space surveillance policy and examines the utility of a nationally assured space surveillance capability.