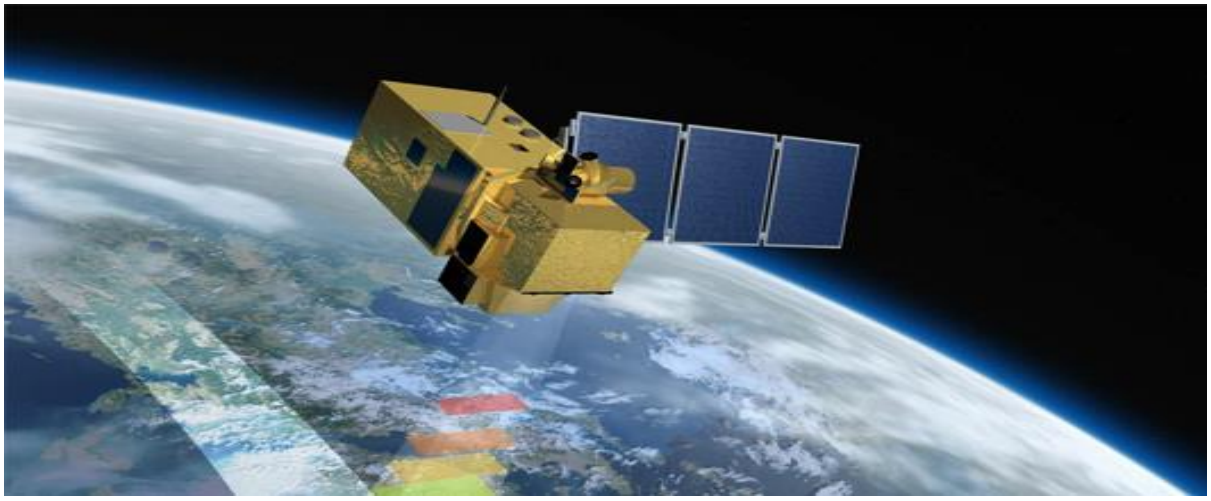
New CEOI-ST Projects Aim to Address Technology Challenges in Remote Sensing



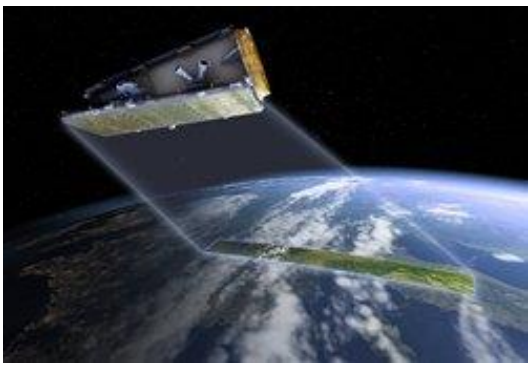
As part of its mission to develop UK capabilities in future space instrumentation for Earth Observation, CEOI-ST has been identifying a range of issues that need to be addressed in the next generation. A series of Challenge Workshops have been mapping the key challenges for scientific research, while an Industry Consultation Workshop identified a range of issues that need to be addressed if the Remote Sensing, Geographic Information Systems, and Unmanned Aerial Vehicle markets are to fulfil their commercial potential.

In scientific research, improvements in technical performance continue to be a key need, particularly for spectral and spatial resolution, sensitivity, and speed of data access. The advent of small, nano and cubesats has also opened up new deployment options in space and created opportunities for a wide range of innovative new missions. However, deployment of remote sensing instruments on these smaller platforms has a wide range of challenges. Size, weight, cost, and power consumption all need to be reduced significantly, whilst delivering the required performance and meeting the challenges in calibration.

In commercial markets, the major need is for improved temporal rather than spatial resolution. An effective way of achieving this is to fly a larger number of smaller, cheaper satellites which can give improved coverage of target geographical areas and provide better continuity of service through their ability to be replaced cost effectively. This need maps well to the emergence of smaller satellite platforms and to the technical challenges for remote sensing instruments of reduced size, weight, cost, and power consumption.

Both the scientific and commercial needs align with the priorities of the UK Space Agency 'Strategy for Earth Observation from Space, 2013-2016', including:

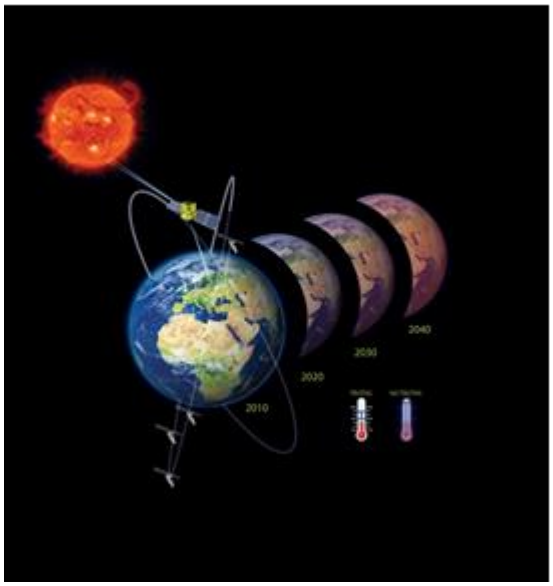
1. Build on UK leadership in processing, analysis, quality assurance and control, modelling and visualisation of space data for environmental research and climate applications.
2. Become global leaders in Synthetic Aperture Radar (SAR) technologies and exploitation especially for civil resilience, natural hazard management and maritime security.
3. Increase UK leadership in developing small, low-cost missions.



The key challenges in deploying remote sensors on small satellites are infrastructure limitations, including attitude determination and control, communications, mass & dimensions, power, propulsion, and thermal control. As a result, there will be a range of constraints on how far different remote sensing modalities can be miniaturised to be deployed on these small platforms. Active sensing modalities such as LIDAR will be limited by the power budget; modalities with larger sensing systems such as high resolution optical imaging or SAR will be limited by size; while modalities with high data rates and processing requirements such as hyperspectral imaging will be limited by bus, comms and onboard computing constraints.

So how are these strategic and detailed challenges being addressed in practice by CEOI-ST? The Centre has just announced funding for a portfolio of new projects which focus on specific aspects of the grand challenges:

Hyperspectral imaging



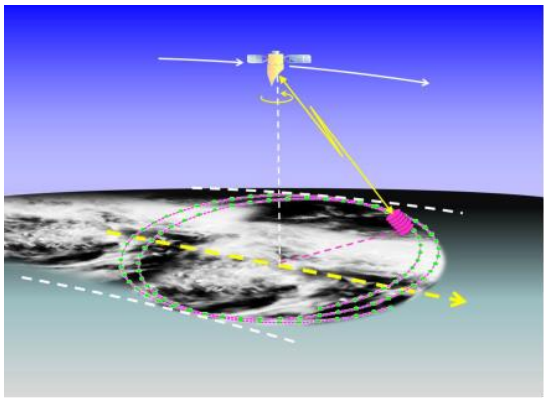
- Improvements in instrumentation and retrieval algorithms of hyperspectral imagers for demonstration of 3D retrieval of NO_2 concentrations over a city scale.

Infra Red

- Benchmark measurements of both incoming (solar) and outgoing (reflected solar) radiation with sufficient spectral resolution / accuracy to detect the subtle fingerprint of climate change.
- Thermal IR mission concept to measure global winds, with 1500km swath-width, day/night operation, providing high quality thermal IR images at 900m resolution, and using proven microbolometer technology.
- Heavy ion testing of the latest large format ROIC technology for MCT infrared detectors using in-pixel avalanche gain for low flux remote sensing.
- Demonstration and assessment of thermal infrared laser heterodyne spectro-radiometry for the remote sensing of carbon dioxide.

Millimetre Wave

- UK contribution to the feasibility study for the Atmospheric Limb Sounding Satellite (ALiSS), leveraging previous UK technology developments in novel millimetre sideband-separating mixer (SHIRM) and Wideband Spectrometer (WBS) developments
- Novel instrument concept to observe ice clouds and humidity using large detector arrays, without mechanical scanning.



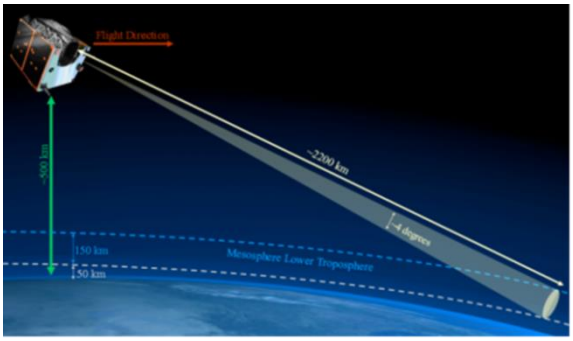
Radar

- Dual frequency, 35 and 240 GHz, Doppler radar with radiometric mode for the detection and quantification of mid and high latitude precipitation.
- Low cost generic measurement system to characterise ferrite materials in their remanent state for use in radar missions from C-band to Ka-band.

SAR

- Conically scanning broad-swath Dopplerised 94GHz radar to provide global measurements of winds, rainfall and cloud ice water content with 50km horizontal and 1km vertical resolution

Terahertz

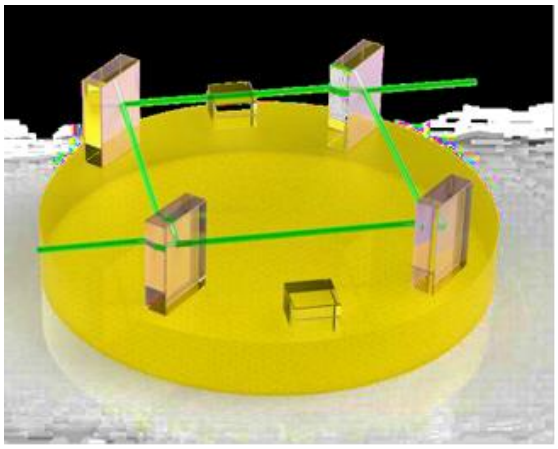


- Novel limb sounding, multi-channel radiometer operating at 0.8 – 5 THz and deployed in low Earth orbit to make global measurements of key atmospheric species in the upper atmosphere

Calibration

- Accurate calibration of SAR interferometic phase for ocean surface current measurement to support the Wavemill concept for global measurements of ocean surface currents.
- Conformal, thin, lightweight meta-reflector (M-R) which is easily attached and possesses a highly stable reflection phase property for ground segment calibration and validation.

Enabling technologies



- Bonded optical assemblies using novel procedures such as mechanised component alignment and bonding, and ground surface active alignment prior to bonding.
- Adaptation for wider use of a contactless power and data transfer device with 95% power transfer efficiency & high reliability data transfer at rates in excess of 5Mbps
- Developing a Frequency Selective Surface to separate the 183 GHz channel from the 166 GHz channel for global temperature and water vapour profiles.

Addressing the larger challenges of increased performance and miniaturisation in Earth Observation instrumentation will require improvements in a wide range of enabling technologies. The CEOI-ST programme is always seeking high quality proposals for projects that are aligned with these objectives.

Further information about these projects and others funded by the CEOI can be found at www.ceoi.ac.uk. You can also contact the CEOI Director, Professor Mick Johnson: Tel: +44 (0)1438 774421 or email: mick.johnson@astrium.eads.net.