EO Enabling Technologies and Techniques:

- Very low loss filters at microwave and submillimetre wave frequencies exploiting computational electro magnetics, precision micromachining and mm-wave metrology.
- A multi-spectral Lidar demonstrator for remote sensing of ground vegetation and to profile forest canopies, important for understanding global carbon sinks.
- On-board processing requirements for an ocean topography synthetic aperture radar instrument.
- Development of a wideband spectrometer for millimetre wave observations using an efficient FFT processing technique.

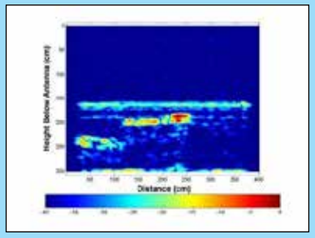
Project leads: Queens University Belfast, University of Edinburgh, Airbus Defence and Space, STAR-Dundee Ltd




Investigation of Future Mission Concepts

- A novel synthetic aperture radar instrument mission (SuperSAR) to measure Earth surface deformation in 3-dimensions, to monitor ice sheet and glacial flow, the geology associated with carbon capture and storage, earthquakes and volcanoes.
- Estimating of the methane flux by the observation of methane ice bubbles trapped within lake ice.
- A low-cost EO mission to measure global wind fields (MISRlite) using uncooled very low mass thermal infra-red detectors.
- Use of high altitude platforms in the form of powered airships flying at 20km altitude for monitoring urban pollution.

Project leads/partners: Univ. of Leeds, UCL, Airbus Defence and Space, Lindstrand and Univ. of Leicester



Training and Development

A long-term CEOI-ST objective is to develop the highly skilled workforce and leadership necessary to maintain the UK at the forefront of the world-wide EO community. The CEOI-ST training and development programme addresses the needs of the academic and industrial community at all stages, from early stage training through to leadership development. CEOI-ST funded projects are encouraged to use the development activities as a training opportunity for younger staff. The CEOI-ST also supports NERC funded studentships on novel EO instrumentation. In total ten CEOI-ST supported studentships have been allocated.

Further Information

More information is available at www.ceoi.ac.uk, or from the CEOI-ST Director:

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UK SPACE AGENCY

Centre for EO Instrumentation & Space Technology

Developing New Technologies to Observe the Earth from Space

Credit ESA

With a vision to develop and strengthen UK expertise and capabilities in EO instruments, the Centre for EO Instrumentation and Space Technology is helping to position the UK to win leading roles in future international space programmes. The Centre was created in 2007 and is funded by the UK Space Agency and industry, with the aim to develop key capabilities through the teaming of scientists and industrialists. The CEOI-ST is a partnership led by Airbus DS together with the University of Leicester, STFC/Rutherford Appleton Laboratory and QinetiQ.

There is significant evidence that man's industrial and other activities are modifying our environment by changing the composition of the atmosphere through emissions of carbon dioxide and other greenhouse gases and through changing land use. Satellite instruments are essential tools to improve our understanding of the processes driving the climate, to provide a health check and to monitor the changes to the environment in which we live. The Centre supports projects to design and build new instruments used in observing the Earth from space.

Technology Programme

The development of new EO instruments and technologies is the main objective of the Centre, including projects carried out by the CEOI-ST partners and those selected through a series of Open Calls. These are held around once per year, resulting in participation of many industrial and academic groups throughout the UK. In all the CEOI-ST has funded more than 30 projects, through a series of major developments and through smaller 'Pathfinder' projects, described in the centre pages. The CEOI-ST also provides support to project teams through the knowledge exchange programme to identify potential spin-out into non-space applications. In the 7 years since its inception the CEOI-ST has made great progress in technology developments and in improving the cohesion of the UK EO community.

Horizon Scanning

Challenge Workshops run by the Centre bring together technologists and scientists to identify future priorities for Earth observation instrumentation. The CEOI-ST has a close working relationship with the National Centre for Earth Observation (NCEO), whose scientists play a key role in the success of the Challenge Workshops, resulting in a list of indicative high priority national, European and international bilateral EO missions. In total the CEOI-ST has held 20 Challenge Workshops and more than 300 scientists and technologists have attended.

Leveraged Funding

In addition to and often as a direct result of the CEOI-ST funded projects, teams have won funding from a variety sources, increasing the overall investment by a factor of two. More than £5.0M in additional funding has been secured over the period April 2007 to March 2014.

Recently, Airbus DS has won a major contract with ESA to develop the MWS Microwave Sounder for the MetOp Second Generation meteorology mission, utilising technology and capability developed under the CEOI-ST technology programme. In addition SSTL has secured a 10 M€ project from ESA, following a CEOI-ST funded technology project, to develop the short wave IR instrument for the Sentinel 5 Precursor mission.

The picture right shows the Minister for Universities and Science, David Willetts at the University of Leicester with the CityScan project, which uses CEOI-ST developed optical technology in a ground based instrument to monitor air quality over an extended volume.

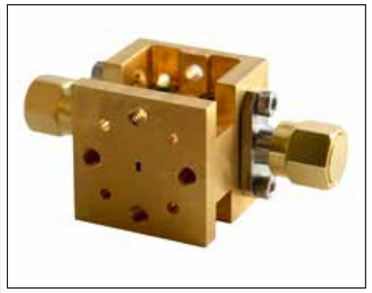
CEOI-ST Technology Programme

The programme supports large Fast Track projects and smaller Pathfinder projects, both selected through Open Calls to the EO community. The technical drive has been to produce instruments for space, but in many cases the resulting technologies have non-space applications.

Passive Millimetre Wave Limb-Sounding Radiometer

The development provides instrument designs and major microwave technology elements for 'STEAM-R', which is a potential joint Sweden/UK submm-wave radiometer atmospheric limb sounding instrument. There are many non-space applications for the technology, including security and defence, analytical instrumentation and pharmaceutical inspection.

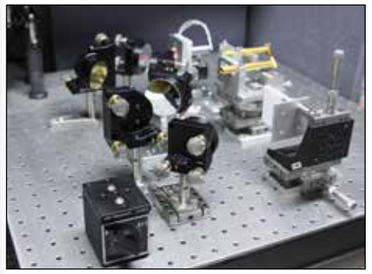
Project partners: STFC-RAL Space with Airbus Defence and Space



Technologies for the MetOp-SG Microwave Instruments

The project is developing important technologies needed for the MetOp Second Generation microwave instruments. These include the on-board calibration scheme, receiver subsystem and quasi-optical system design and analysis, and the mechanical scanning mechanism. The work will significantly de-risk the technologies required for the next generation instruments for ESA and Eumetsat.

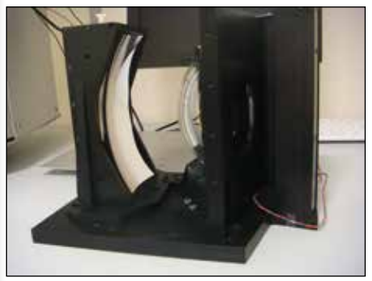
Project partners: Airbus Defence and Space with SEA, STFC-RAL Space and JCR Systems



'CompAQS' UV/VIS Spectrometer For Gas Analysis

This compact and novel optical system uses ultraviolet-visible (UV/ VIS) spectro-photometric techniques to measure regional air quality from space. Further development of the concept led to the 'CityScan' project and the construction of terrestrial rooftop mounted spectrometer systems for the retrieval of nitrogen dioxide and aerosol concentrations (420 to 590 nm). The rooftop instruments will provide 3D gas concentration measurements and aerosol information across whole urban areas every 10 minutes.

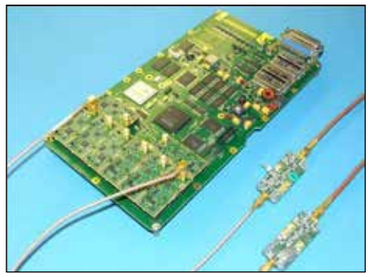
Project partners: University of Leicester with SSTL



Instrument On-Board Processing For Thermal Infra-Red Detectors

Spaceborne instrumentation has an increasing need for high performance on-board digital signal processing to handle the large volume of data from modern high resolution sensors. The project has developed a demonstrator of a 2D thermal infrared detector array system and its associated signal processing unit for use in Fourier Transform Spectroscopy (FTS).

Project partners: Airbus Defence and Space with Selex Galileo, STFC-RAL Space and University of Leicester



GNSS Reflectometry

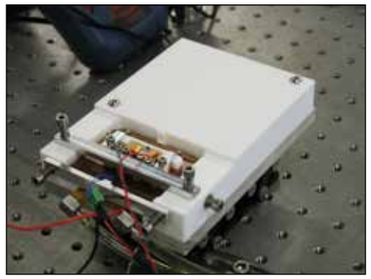
This project is developing a flexible multi-channel receiver of reflected GNSS signals for surface sea-state measurements. Signals from GPS/ GNSS navigation satellites reflected from land, ice and ocean can be analysed with an instrument flying on a separate small satellite to derive important scientific data on the nature of the reflecting surface and the atmosphere. Measurements of ocean roughness are important for operational ocean and weather forecasting. The receiver is to be flown on the UK TechDemoSat-1.

Project partners: SSTL with NOC, Universities of Surrey and Bath

Technology For Optical And Laser Systems

Hollow optical waveguides are a novel approach to optical and laser systems manufacture and the optical equivalent of the electronic printed circuit board. The technology provides a fundamentally new way of manufacturing compact, low mass, low cost optical systems which maintains optical alignment in harsh vibration and thermal environments. The team have investigated applications for Lidar and other complex optical instruments.

Project partners: HollowGuide Ltd with STFC-RAL Space



High Resolution Radiometry In The Infra-Red

The Laser Heterodyne Radiometer uses a low-power, highly-stable quantum cascade laser, mounted in a hollow waveguide, to down-convert the incoming infra-red radiation into the radio-frequency domain, providing high spectral resolution, sensitivity and spatial resolution. Potential applications include stand-off detection for industrial pollution monitoring, defence and security, planetary exploration and astronomy.

Project partners: STFC-RAL Space with HollowGuide Ltd

Pathfinder Studies

These are smaller studies to investigate innovative ideas which can enable future EO missions.

Optical Technology:

- The use of immersed diffraction gratings or 'Grisms' to provide higher spectral resolution than conventional gratings of the same size
- A small breadboard instrument showing how 'integral field spectroscopy' with an array of micro-lenses can provide many hundreds of spectra in an image plane
- A study of an instrument using a precision image slicing mirror to reformat the focal plane and feed into a long-slit spectrometer, for use in climate monitoring

Project leads: SSTL, University of Durham, UK Astronomy Technology Centre