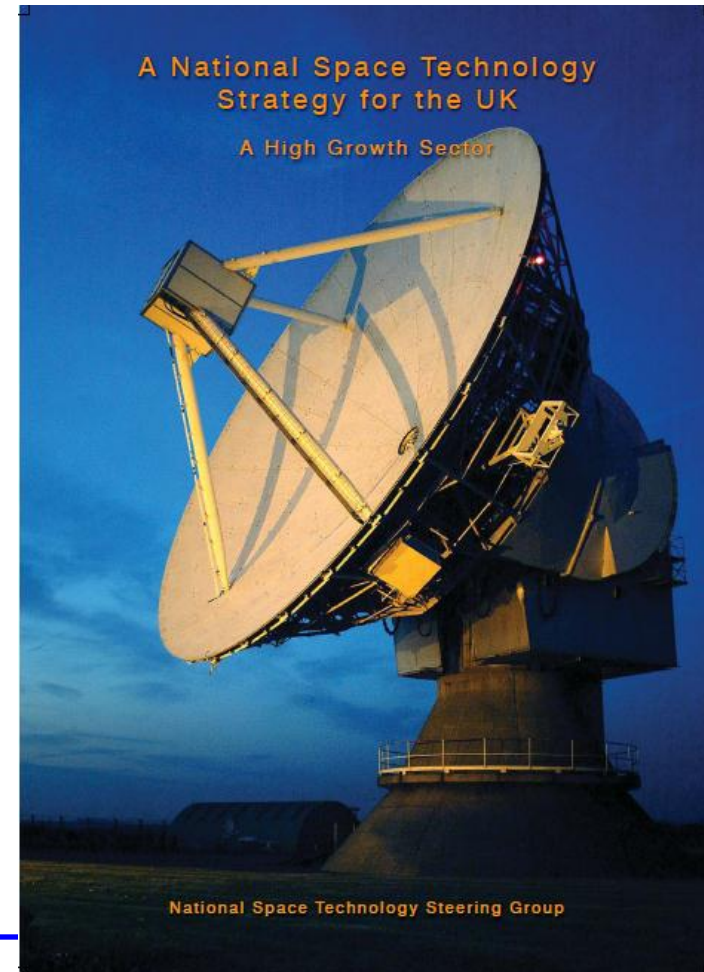

CEOI Projects - Collaborative Opportunities

Mick Johnson
CEOI Director

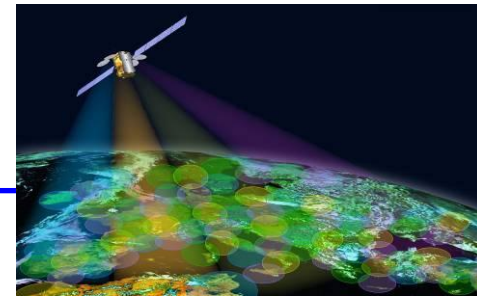
23rd January 2013

- National Space Technology Strategy
- Space technology roadmaps
- Sensing technology database
- CEOI technologies
- Future opportunities

- Objectives for the Innovation and Growth Strategy
 - economic growth and stability;
 - creation of highly skilled jobs;
 - development of new knowledge and business opportunities;
 - generation of tangible revenue for the economy
- The IGS is aiming for 10% share of £400bn space market by 2030 – currently £9bn per annum (6%)
- Recommends investment rising to £100m pa by government and industry
- Aims to span the public service and commercial markets, including climate monitoring and security services
- The National Space Technology Strategy is supported by sector roadmaps, developed by five National Technical Committees (NTCs)



Space Roadmap NTCs

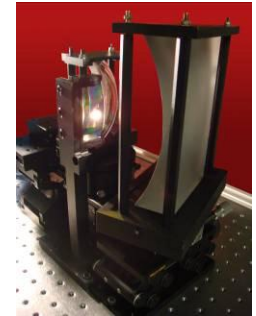


Telecomms

- Markets: Satellite broadband, enterprise, broadcast, transport, security and environment
- Technologies: Payloads, platforms, antennae, RF equipment

Sensing

- Markets: Space science, EO science, meteorological, commercial
- Technologies: detectors, optics, radar, microwave etc



Robotics and Exploration

- Market: Significant spin-out into terrestrial market
- Technologies: Rovers, landers, penetrators, in-situ resources...

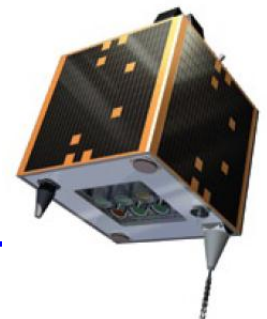


Position, Navigation and Timing

- Existing/planned GPS and Galileo space infrastructure
- Technologies centre on future services (location and timing eg in transport)

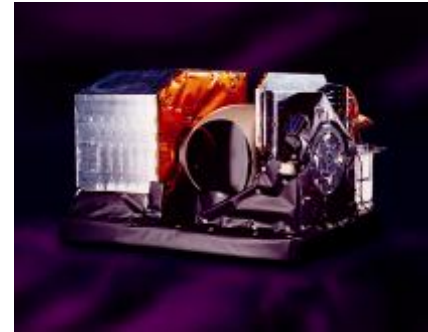
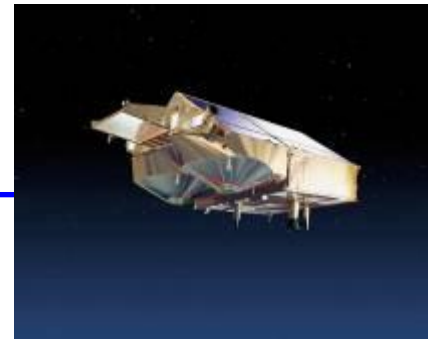
Access to Space

- Diverse set of markets and technologies to deliver payloads to space
- Includes launchers, platforms and enabling legislation



What is sensing?

- **Definition:** Sensing is the set of space and ground systems to allow generation of useful data, together with the exploitation of that data for scientific and commercial applications
- **Scope includes:**
 - Active and passive sensing systems
 - Space in-situ sensing
 - Downstream activities, ground segments, applications
 - Sensors to support space situational awareness
- **Outside scope:**
 - Rover and lander technologies, other than the sensing systems, are covered in 'Robotics and Exploration' roadmap
 - Spacecraft/platform technologies are in 'Access to Space' roadmap



Sensing Roadmap Scope

Market Opportunities

➤ **Market characterised in 2009 IGS Report**

- Space, planetary and EO science
- Monitoring the planet – Environment and climate
- Commercial EO applications, Security and defence
- Products for export missions

UK Capability

Very wide range of capability identified:

- Detectors (visible, IR and microwave); Optical and microwave; active and passive systems; planetary in-situ
- Capability chart based on data from UK Space Directory

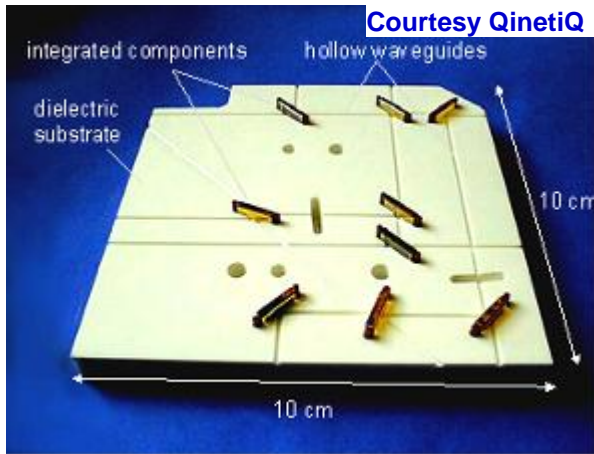
Research Themes

140-150 UK-based technology items identified and described

- Technologies categorised into 30 technology areas:
- Clustered into 10 sensing themes
- Includes products and technologies
 - E.g. Advanced UV/visible detectors, optics for Lidar, in-situ instruments

CEOI Technology Developments

LIDAR technologies in 1.5-2.5 μm range for CO₂ measurement

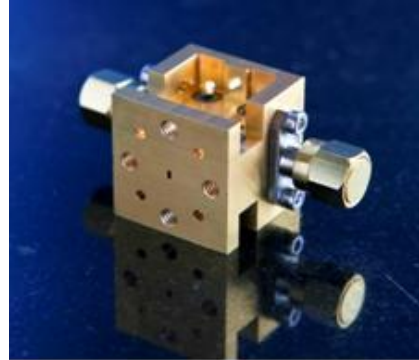


Integrated Optics
Hollow Waveguide

QinetiQ with Uni. Of
Leicester and CTCD

Millimetre wave radiometric
sounding of the atmosphere

STFC/RAL with Astrium and QUB



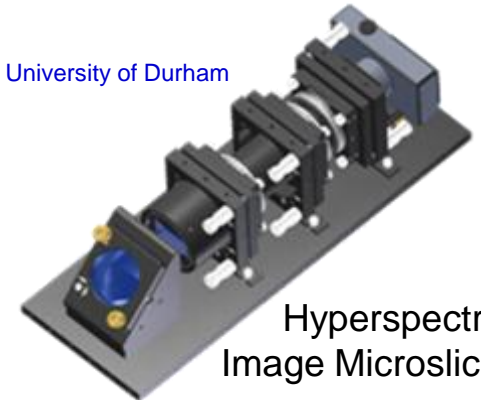
SHIRM 360 GHz image
separator mixer using Schottky
diode technology

GNSS Reflectometry



SSTL with NOCS, Univ. of
Surrey & Bath, PolarImaging

University of Durham



Hyperspectral
Image Microslicer

Queens University Belfast

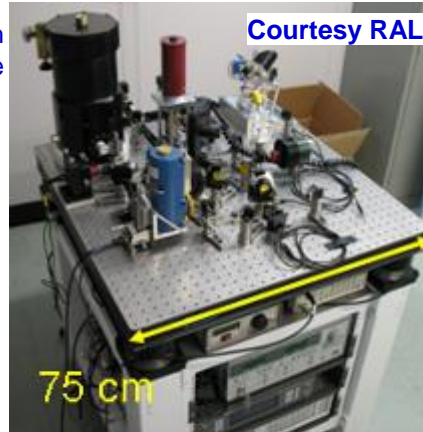
Courtesy SSTL



Spectrometers and detectors
in UV/Vis/NIR for atmospheric
composition measurement

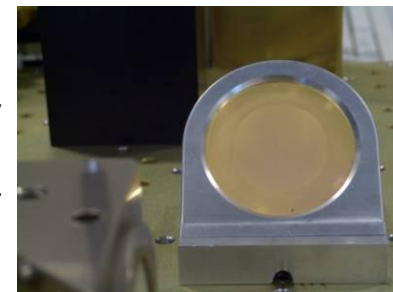
STFC/RAL with
HollowGuide

Courtesy RAL



Laser heterodyne sounding
in 4-150 μm range

Frequency
Selective
Surface Filter



Spinning in non-space technologies

1st bench top instrument
1x1 m²



Laser Heterodyne Radiometer

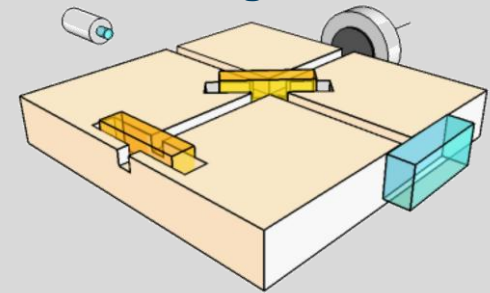
Monitoring emission and composition

Potential for Earth obs and planetary missions

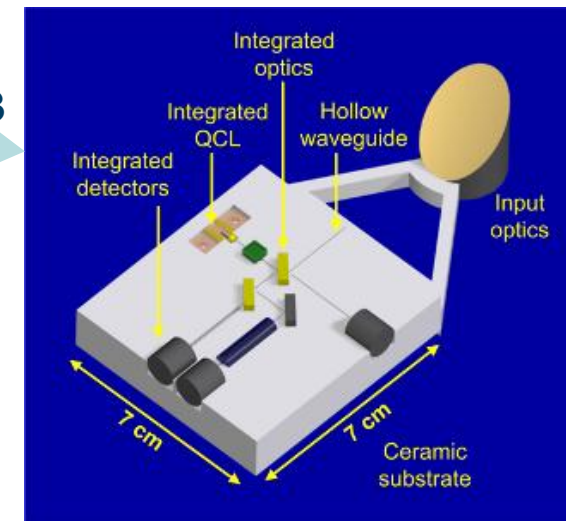
Monitoring urban areas

2007

Hollow waveguides



Integrated instrument concept - 7x7 cm



Miniature integrated instrument

- Using hollow waveguides (spin-in from aerospace) in an existing instrument concept
- Leads to smaller more robust instrument with lower cost and improved performance

2013

License or Collaborate

Potential technology areas available for licensing or for collaborative development include:

Technology Theme	Capabilities
Infra-red	IR detectors, spectrometers and optics technologies
LIDAR	Beam scanners, optics, system development, laser sources
Passive Microwave	Detectors, instruments, quasi-optics
Radar	SAR/Radar front end and back end
UV/VIS	Advanced high res spectrometers, UV/VIS detectors, imaging and optical technologies
X-Ray/Gamma	Instruments, neutron optics, detector technologies

Collaborate or Supply

Technology Theme	Development Areas	Advances Needed
Infra-red	Advanced IR detectors Imaging array detectors Laser sources MCT arrays & optical technologies	Low noise Low light level detection Power scaling Efficiency enhancement Lenseless imaging
LIDAR	Laser Sources Optics for Lidar Detectors	Multi-spectral laser sources Wave Guides Improved spectra, temporal, horizontal, vertical resolution
Passive Microwave	Passive microwave technologies Passive microwave instruments	Higher pixel numbers Higher sensitivity Steerable antennas High gain antennas and electronics
Radar	SAR/Radar front end SAR/Radar RF and back end	Multi deployable antennas/structure High data rates Reconfigurable electronics Operability at different SAR bands
UV/VIS	Advanced UV/VIS detectors Optical technologies	Resolution Radiation hardness Spectral resolution Low noise Active functionality Surface finish

How to engage

- Networking opportunities
- Enquiry sheets
- Contact details

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Today and afterwards