

Centre for EO Instrumentation
& Space Technology



CEOI-ST Industry Consultation Workshop
Summary Report
“Millimetre / Passive Microwave / Terahertz Sensing”

7th May 2015

MRC Offices, London

There is growing interest in the millimetre, microwave, and terahertz sections of the electromagnetic spectrum from the earth observation, defence, medical and other sectors for a range of applications including remote sensing, communications, medical diagnostics, production control and spectroscopy. These sectors have common technical challenges in exploiting this part of the EM spectrum and application needs are often similar enough for solutions from one sector to be migrated to another.

The round-table consultation brought together industry representatives from all of these sectors to discuss and provide input on market trends, challenges and opportunities that will inform CEOI-ST's strategy for the next generation of earth observation / remote sensing instruments.

The meeting aimed to:

- briefly illustrate how Earth Observation instruments are developing and the research focus for the next generation
- brainstorm with industry representatives the key service, technology, and data needs for current and future products and services
- investigate the possibility of brokering relationships with interested parties along the supply chains for promising new applications / markets
- create opportunities for attendees to network across the different communities

The discussions identified a wide range of application interests and challenges in this part of the EM spectrum which are summarised in the tables on the next page.

The main areas of potential terrestrial applications were identified as security, defence, medical, industrial process, gas turbine, and environmental monitoring. However a number of technical challenges remain, and at present there is insufficient market pull to justify significant industrial and commercial investment. CEOI-ST projects for Earth Observation should be monitored to identify those which may help overcome these barriers for terrestrial exploitation.

CEOI-ST will continue to support development of these technologies for earth observation from space, and to ensure that opportunities are pursued for technology transfer to/from non-space developments. The inputs and conclusions of the workshop, as summarised in this report, will provide an important input into the strategy development process for the CEOI-ST programme.

To support commercial deployment in the terrestrial market of microwave, millimetre wave and terahertz technologies developed for earth observation instruments, and to enable utilisation of the data from them in products and services, a wider UK strategy, supported by other research and innovation agencies such as EPSRC, STFC, and Innovate UK, will need to address the following issues:

- Improved capabilities in stand-off detection
- Improved capabilities in gas detection
- Analytical techniques for materials inspection
- Identifying limits on usage in lower atmosphere due to absorption by water vapour
- Improved analytical software and image processing
- Improved applications testing infrastructure to enable industry to try out different ideas and proposals. Facilities along the lines of the Fraunhofer Institutes would help to overcome barriers to demonstrating applicability to market. The Catapults are working in this space, but none is relevant to these particular challenges

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

Markets & Applications	Challenges
Security	Explosives, weapons and drug detection for parcels in the logistics sector
	Improvements in the speed, accuracy, and false positives / negatives of alternative people screening technologies to x-rays
	Improved remote sensing at a distance for explosives and drugs with more accurate analysis and reduced false positives / negatives.
Defence	Multiple target identification
	Flying such detection systems on UAVs, which provides challenges of miniaturisation, power, data management, and download speeds?
	Innovative improvements in communications
	Through-wall imaging
Medical	Cost reduction and sensing in the home
Process	Monitoring average composition changes with small, low power & cost detectors
	Catalysis / acceleration of chemical reactions
Environment	Detection of hydrocarbon leaks over large industrial facilities, from refrigerators in warehouses and retail facilities, from fracking sites and waste dumps
Gas Turbines	Gas analysis of exhaust plumes and spatial distribution of chemical species
	Chemical species monitoring in engine test beds; many chemical species and radicals can't be detected
	Remote sensing of internal parts and processes of an engine where it is difficult to deploy in-situ sensors.
	High bandwidth comms to transmit operational data from sensors in the engine during flight for continuous monitoring applications.
	Assessment of new materials such as composites.

Technical	Challenges
Sensing	Stand-off gas detection
	Exploitation of "signals of opportunity" for sensing
	Monitoring the location of terrestrial emissions using LEO satellites
	Analytics on back end of the sensing chain to aid users and to enable autonomous decision making
Miniaturisation	Applications pull-through to drive and fund further progress
	Reduction in antenna size
	Cheap, compact cooling technologies
	Ambient temperature sensors
Cooling	Smaller, cheaper, more efficient thermoelectric cooling technologies
Cost	Reducing cost, power consumption and increasing operational efficiency are requirements across the board
Antennas	Electronically steered multi-element antennas for major savings in costs.
Communications	Terahertz communications for higher bandwidths and data transfer