

**Centre for EO Instrumentation
& Space Technology**



**CEOI-ST Industry Consultation Workshop
Summary Report**

**“HyperSpectral & Optical Sensing and Detector Technologies
in the UV / Vis / IR Spectrum Range”**

15th October 2015

University of Leicester

Sensors for UV, Visible and IR radiation are amongst the most widely used detection technologies and find extensive applications across the medical, defence, security, process, aerospace, environmental, energy, and research sectors. These sectors have common technical challenges in exploiting this part of the EM spectrum and their 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 technical challenges in this part of the EM spectrum which are summarised in the tables below.

Application interests that were discussed included monitoring of gas turbines, hazardous and flammable areas, flood and disaster situations, diffuse / dispersed water pollution sources, process plant operation, and down-well operations. Tracking of individuals and human activities from their trace gas emissions was also of interest.

The delegates also highlighted a range of technical challenges to solve, if UV / Vis / IR sensing is to address new monitoring challenges and applications. Challenges include sources, ambient temperature detectors, improved sensor performance, miniaturisation, cost reduction, image processing for change detection, fusion of data from different sources, computational imaging, registration between images, calibration and validation of sensors, understanding data quality, and long-term calibration of sensors.

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.

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@airbus.com

Markets & Applications	Challenges
Flammable & Hazardous Areas	Remote Sensing
	Intrinsically safe sensing technologies
Security and Health & Safety	Security: identification of who or what is in a building and what activities are underway by stand-off detection of NO ₂ , CO ₂ , O ₂ and other species
	Health & Safety: monitoring of lone workers in remote or hazardous areas by remote monitoring of NO ₂ , CO ₂ , O ₂ and other species
CubeSats and UAV Crossover	Redeployment of miniaturised, low mass, and low power technologies from CubeSats into UAV applications
	Understanding the sensing capability to support the definition of the backend processing
	Redeployment of ultra-low power and high capacity processing capabilities for backend data processing
Environment	All weather remote sensing of water quantity and levels
	Detection and monitoring of diffuse or dispersed sources, such as agriculture and run-off from road networks, for chemical and biological monitoring of water quality

Technical	Challenges
Trace Gas Measurement Technologies	Sources - thermal and lasers
	Detectors - pyrotechnic detectors and bolometers
	Room temperature photonic detectors in the near IR region with high sensitivity
Temperature Measurement	Temperature measurement sensors at wavelengths of 10 microns
	Low mass, low cost, compact, ambient temperature sensors
	Cheap, compact cooling technologies
Cooling	Smaller, cheaper, more efficient thermoelectric cooling technologies
General Performance Improvements	Improved sensor performance for accuracy, environment, and time response
	Room temperature sensors
	Low cost (this is a big driver).
	Miniaturisation and low cost for expendable systems
Ambient Temperature Sensing	Un-cooled IR bolometers
Signal/Data Processing and Data Fusion	Image processing for change detection, analysis and identification of targets of interest.
	Fusion of data from different sources - polarimetry, fluorescence, hyperspectral. How can this data be processed, fused and understood in order to enable a decision in a short time frame.
	Modelling of gases at very high temperature (1500+ °C) for detection of O ₂ , CO, leaks, etc.
	Computational imaging
	Registration between images in formation flying is of interest for terrestrial imaging applications.
Instrument Characterisation / Calibration / Validation	Calibration and Validation between ground based sensors and space based measurements, and modelling to link the two.
	Understanding data quality by calibration and characterisation of the equipment to understand the uncertainties in the system.
	Understanding of the measurement techniques for essential climate variables and the uncertainties in those measurement techniques
	Long-term calibration of sensors