Centre for EO Instrumentation

**Technology Market Case Study No. 5**

**Compact Differential Optical Absorption Spectroscopy**

***The Idea***

Smaller, cheaper and lighter instruments are needed for remote sensing and measurement of atmospheric air quality across entire cities from a range of platforms, including small satellites, aircraft, drones, vehicles, and fixed ground stations. The CompAQS is a novel spectrometer design, which uses concentric optics to produce a very compact remote imaging spectrometer instrument. Operating in UV/Visible region, it uses the Differential Optical Absorption Spectroscopy (DOAS) technique to detect polluting substances.

***Support from CEOI***

In order to turn this idea from concept to proven technology, CEOI provided a series of funding tranches to define applications, specify technical requirements and develop a compact DOAS spectrometer. **Phase 1** funding supported the instrument development from concept to a working breadboard at TRL 3/4 while **Phase 2** funding enabled the instrument to demonstrate full imaging DOAS capability and develop concepts for suitable imaging optics, detectors, structure and retrieval algorithms. The **Open Call 5** enabled application development to 'Measure Nitrogen Dioxide in the Urban Environment' and **Open Call 6** supported the 'Flying of the CompAQS Air Quality Instrument as an Airborne Demonstrator to Map NO2 over Leicester at High Resolution'. Finally, **Open Call 7** funded a study into application of a hyperspectral imaging suite for 3D retrievals and **Open Call 8** funded improvements in the design and TRL level of high risk items including structural/thermal design, focal plane design and alignment issues.

***The Result***

The outcome of the funding was the successful development of the CompAQS instrument and demonstration on both aircraft and ground stations for the remote measurement of atmospheric air quality across entire cities. At the end of the programme, the instrument was at TRL Level 5, with 6 papers being published.

***Wider Deployment***

The CityScan project has been a very successful spin-out from the CEOI funded CompAQS project, attracting over £420k of NERC and RDA funding to develop a very promising service to monitor urban and other terrestrial environments in 3D and in very near real time.

Bluesky Ltd, an aerial survey company, has also flown a CompAQS instrument in aircraft as part of its Air Quality Mapper (AQM) service.

A strong collaborative relationship has been established between the University of Leicester and Surrey Satellite Technology Ltd, strengthening the UK capability in UV/Visible spectroscopy. Three CityScan instruments were built and tested in Leicester and successfully deployed in London to monitor air quality during the Olympics in 2012 as part of the NERC-funded ClearFlo project.

***CEOI***

The Centre for Earth Observation Instrumentation (CEOI) works with UK organisations, both academic and industry. Its objective is to develop a world leading, internationally competitive, national Earth Observation (EO) instrument and technology R&D capability. The CEOI is funded by the UK Space Agency with parallel technology investment from industry. Its key aim is to develop UK capabilities in future space instrumentation for EO through the teaming of scientists and industrialists.

Further information about this technology 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@airbus.com.