Research and development in the EMRS DTC

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The Electro Magnetic Remote Sensing (EMRS) Defence Technology Centre (DTC) is now in its sixth year of operation. It has played a key role in broadening the supply base for the delivery of MOD's science and technology objectives in areas relevant to remote sensing through a closer collaboration between industry and academia. The DTC consortium, led by Selex-Galileo as prime contractor, also includes Thales UK Ltd, Roke Manor Research Ltd and Filtronic Plc. Through their positioning in the supply chain, the consortium partners are able to influence the exploitation of research activity supported under the DTC, so providing a broad front on which to address some of the challenges facing the defence community.

The objective of the DTC's programme is to research and demonstrate innovative and cost-effective sensor technologies in any parts of the electromagnetic spectrum, which can substantially improve the detection, location and/or identification of military targets, including operational contexts at longer range and in adverse weather. As such, the research is potentially applicable to air, land, sea or space-based sensing systems. The changing nature of conflicts with increased levels of asymmetry has led to a shift in emphasis to include the consideration of challenges faced in the urban theatre. Thus the DTC has become more concerned about areas of technology that show promise for meeting a wide range of requirements in areas such as through-wall sensing and the detection of improvised explosive devices. Its research programme is structured around four broad technical themes ranging from fundamental physics to the exploitation of innovative technologies in remote sensing. These themes are:

- Radio Frequency (RF) systems, covering both active and passive sensors ranging from low frequencies to THz
- Electro-Optic (EO) Systems, covering active and passive systems in the ultra-violet, visible and infrared bands
- Transduction Devices and Materials, covering critical enabling electronic system technologies, with a strong emphasis on cost-effectiveness
- Transducer Embedded Processing, covering processing-intensive sensor improvements

The benefits of cross-fertilisation between the different sensing technologies are being addressed through the investigation of areas of commonality and exploiting multi-function and multi-sensor techniques to improve sensing capabilities. DTC resources are allocated strictly on merit through the application of an assessment process that includes both Industry and MOD representatives. Through the application of this process SMEs and Universities have been awarded approximately 30% of the available resources. Further details can be found via http://www.emrsdtc.com/programme.htm. The EMRS DTC opens its entire programme to competition on an annual basis. A call for proposals is issued in the Autumn, leading to a down-selection of candidate offerings by a multi-stage process of peer review, involving the research director, DTC consortium members, Dstl Knowledge Integrators and Academia. Once ratified by the DTC's Supervisory Board, work is usually funded for a period of 12 months, with a requirement to present the outcome of the work at the DTC's Annual Conference. This conference provides a key mechanism for the dissemination of the results of the DTC's activities and the papers presented are archived on the DTC's web site (see http://www.emrsdtc.com/conferences/2008/conferences.htm). The following papers have been chosen as representative of material presented at the June 2008 Conference, and cover a number of areas of significant importance.

In the area of RF Systems, the paper on the "Effects of Mutual Coupling in TSA Arrays", underpins a project at Selex Galileo on the realisation of ultra-wideband arrays for RF systems. The path towards an integrated array has already been demonstrated by Selex Galileo, covering the band from 4–18Ghz, with an addressable scan angle of 60°, which in turn underpins the development of strategy for the realisation of multifunctional RF systems on unmanned air vehicles. In contrast, the paper on "Easily Deployable, Multifunctional Radar Networks", addresses the exploitation of low-frequency radar networks for unmanned ground sensors, to provide enhanced levels of situational awareness, including the detection of movement inside buildings.

Challenges in the operability of radars in coastal environments, where problems of sea-clutter can reduce the ability of radar systems to detect fast in-shore attack craft (FIACs), are addressed in the paper "Radar Sea Clutter in Littoral Waters". The fourth paper in the RF systems theme "Design Studies for an Airborne Collision Avoidance Radar" is concerned with the development of a novel form of radar exploiting multiple-input, multiple-output (MIMO) techniques. This has the potential of enabling unmanned air vehicles to operate in the close vicinity of other aircraft, without compromising levels of safety in air operations.

Requirements for high-power, high-frequency electronic devices are being addressed by the EMRS DTC in a number of projects, including activity on gallium nitride at QinetiQ and at Sheffield University. The paper on "Alternative High Power RF FETs Based Upon CVD Diamond" takes a different approach by seeking to exploit the high levels of performance available in devices fabricated using single-crystal diamond technology.

In the EO Systems arena, the DTC has been supporting work at Thales Optronics Ltd on the development of on-focal-plane approaches towards discriminative imaging (such as for mine detection) in a robust camera system, capable of rapid transition into theatre. Progress on aspects of the work is summarised in the paper "Build and Assessment of QWIP-based LWIR Polarimeter" and includes some sample images from the Dstl HydraVision trials held at Porton Down in March 2008. In contrast the paper on "High Resolution Imaging using LuckyFrame Selection" highlights an efficient phase-diversity approach to solving the problems of aberration when attempting to image at long-range through atmospheric turbulence.

Requirements for improved resolution in persistent surveillance are driving the approach summarised in the paper on "Temporal Resolution Enhancement from Motion". This technique is already being considered for incorporation into the next generation of UK electro-optic turreted systems. The last of the EMRS DTC's group of papers "Building Aerial Mosaics for Visual MTI", explores the challenges of building a mosaic of ground scenes from airborne imagery and using the assembly to detect and track the positions of moving objects. This process requires a front-end that discriminates moving targets from other objects in the scene that appear to move as a result of camera motion.