



MINISTRY OF DEFENCE



SELEX GALILEO

BAE SYSTEMS

THALES



Roke Manor Research Ltd
a Siemens company

EMRS DTC
Electro-Magnetic Remote Sensing (EMRS) Defence Technology Centre (DTC)

Tony Kinghorn
Selex Galileo

EMRS DTC Research Theme Leader
RF Systems

RF Systems Research Theme - Overview



Science Providers

Technical Areas

Military Drivers

- Target identification
- Multi-Function Systems
- Detection of new and difficult target classes
- Situation Awareness
- Battle damage assessment
- Improved exploitation of existing sensor capabilities
- Affordability

- Networked RF Sensors
- Non Cooperative Target recognition
- THz sensing
- SAR systems studies
- Microwave photonics
- ESM and passive RF sensing
- UWB technology
- Signal and image processing
- MIMO Radar

- University of Edinburgh
- University of Birmingham
- Defence College of Management and Technology, Cranfield
- TW Research
- eOsphere
- DLR, Germany
- Sula Systems
- Liverpool John Moores University
- ESL Defence
- Phasor Solutions
- Roke Manor Research
- RFMD
- Teledyne, Australia
- BAE Systems ATC
- University of Aberdeen
- QinetiQ
- Selex Galileo
- Thales
- TNO, Netherlands
- University College London
- ThruVision
- Queen Mary University of London

Current Research Projects

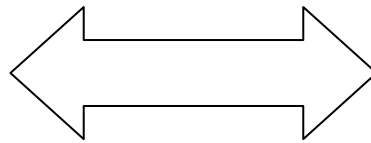
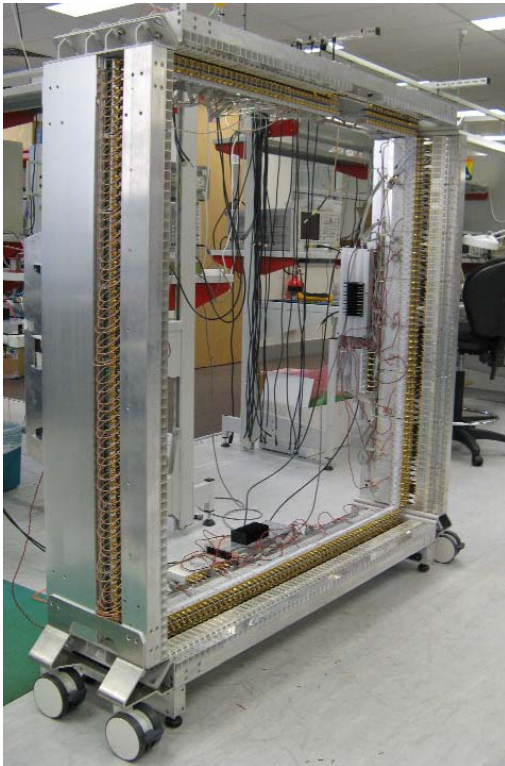
- Tomography and Polarimetric Interferometry for enhanced target detection (*eOsphere & DLR & University of Edinburgh*)
- Multi-Octave Phased Array Apertures (*BAE Systems ATC*)
- Dual Polarised Array Antennas (*Selex S&AS*)
- Bistatic Synthetic Aperture Radar with Emitters of Opportunity (*University of Birmingham*)
- MIMO Low Visibility Landing Aid (*Teledyne Pty Australia*)
- Calibration of Overfilled Highly Coupled Arrays (*Selex S&AS & Queen Mary University of London*)
- STAP Radar Signal Processing for Real World Environments (*University of Edinburgh*)
- Multi-Scan Spatio-Temporal Discrimination for Small Target Detection (*QinetiQ*)
- 3-D Mapping of Buildings (*TNO, Netherlands*)
- Sub-THz Imaging for Buried Object Detection (*ThruVision*)
- Forward Scattering Micro-Sensors for Intruder Detection and Classification (*University of Birmingham*)
- Sampling Techniques for Broadband Electromagnetic Scanning (*University of Edinburgh*)

Difficult Targets- Three Different Approaches to Radar Imaging

- **Large 2D MIMO Aperture** (Teledyne Pty.Ltd.)
 - Short Range 3D Microwave Imaging
- **1D MIMO, 1D SAR** (TNO)
 - ‘Drive-By’ building mapping through 3D imaging
- **SAR Tomography** (eOsphere, DLR)
 - Long range 3D imaging using multiple SAR passes
 - Target detection under foliage

MIMO Stand-Off Microwave Imager

- 128x128 element demonstrator (2.5m square) operating at 35GHz, capable of resolving 1cm targets at 7m range
 - Only requires 512 physical elements (256 Tx, 256 Rx) to synthesise equivalent of 16384 element array
- Remote security scanning in cluttered environments



Images courtesy of Teledyne Pty. Ltd.

Building Mapping Radar

- **‘Drive-By’ MIMO**

- **Polarimetric SAR**

- Low frequency to provide building penetration
- Polarimetric interpretation to extract building features
- 3D capability with vertical MIMO aperture and horizontal synthetic aperture

- **Situational Awareness for Urban Warfare**

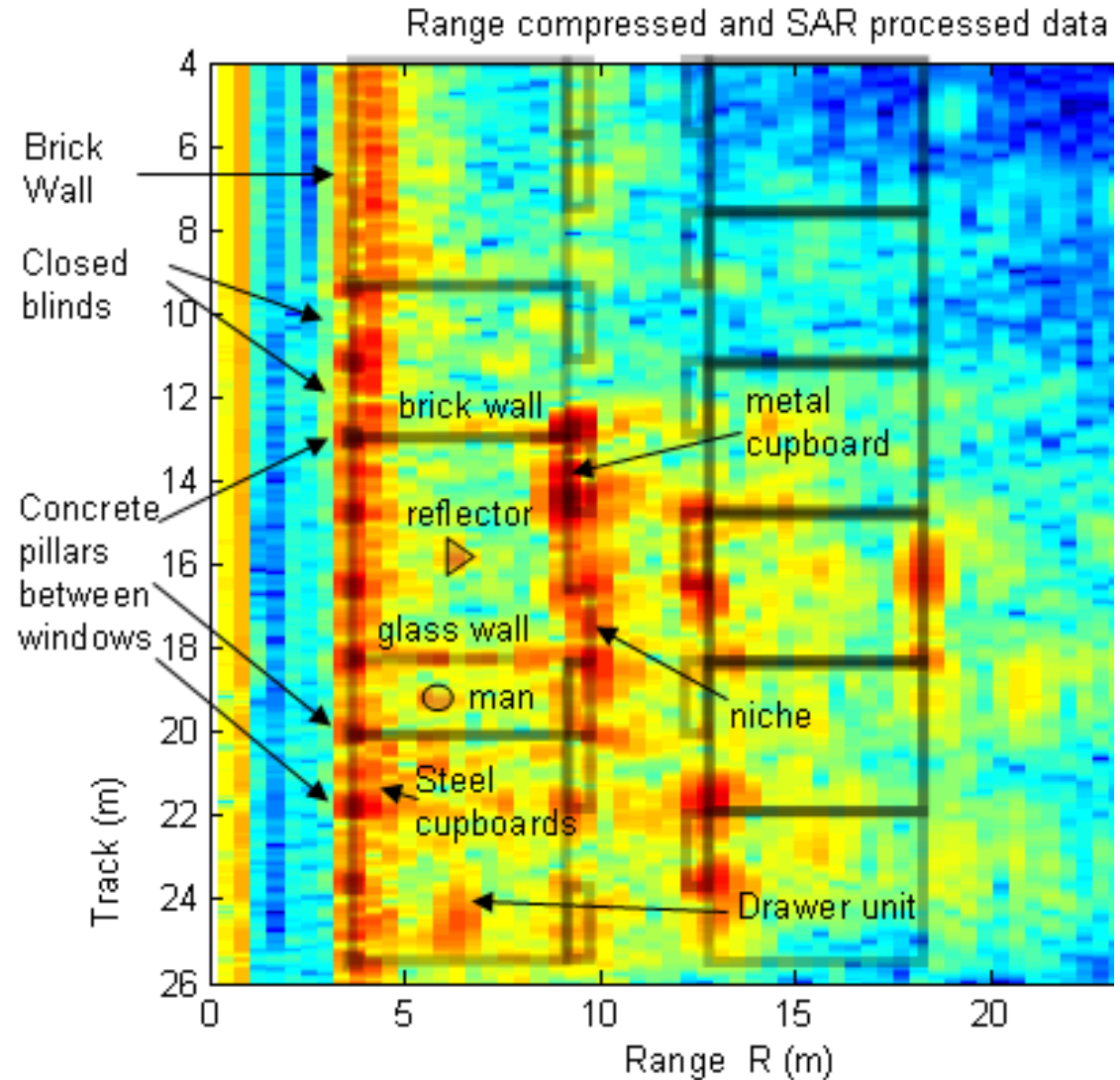
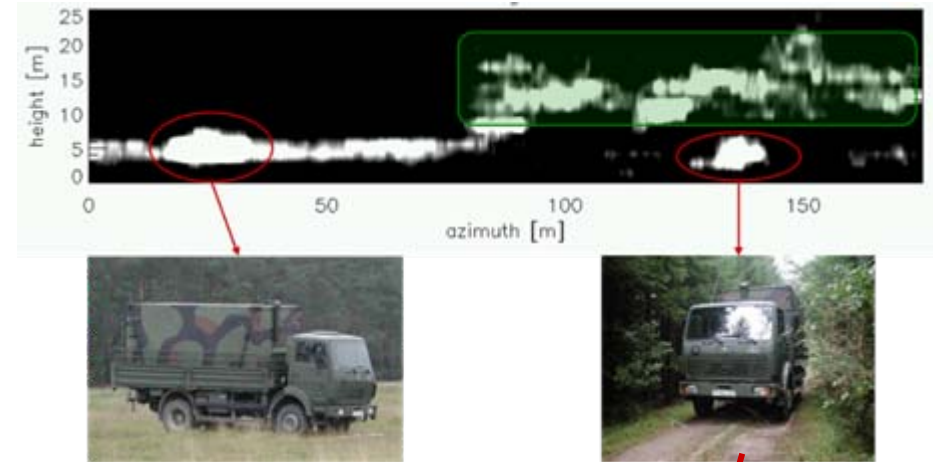


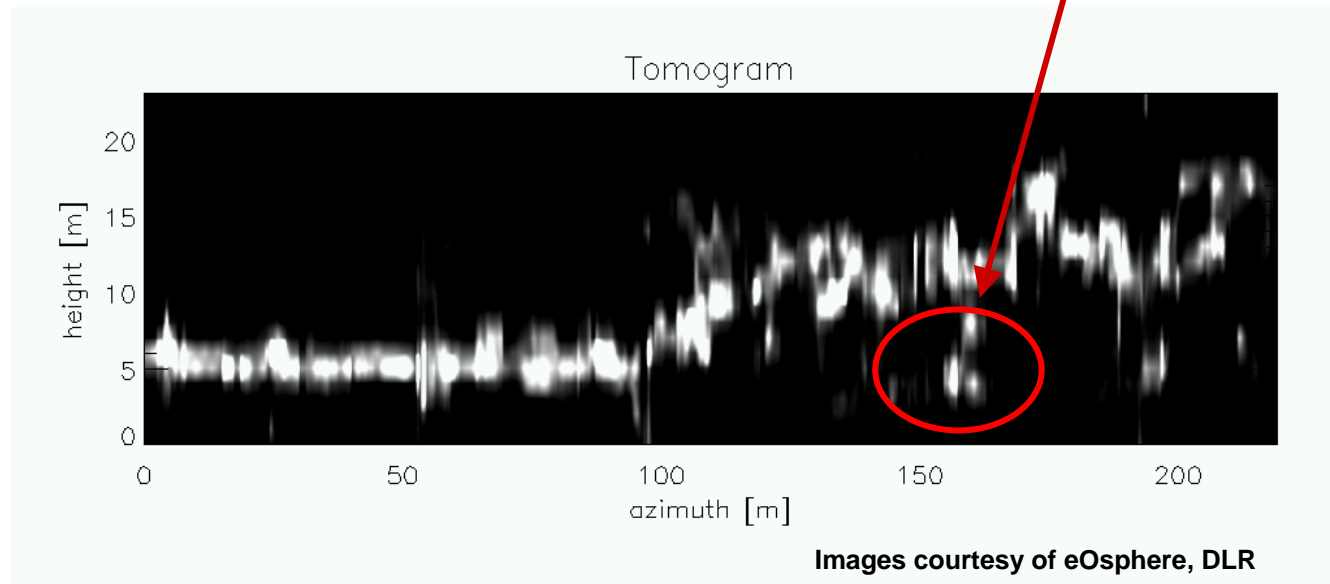
Image courtesy of TNO

Foliage Penetration

- **SAR Tomography: 3-D picture** of a scattering volume, in contrast to the usual 2-D SAR image
- **First demonstration** of target detection under foliage using tomography
- **Practicality-** elimination of need for corner reflectors for calibration, reduction in number of passes (24 -> 6)



Tomographic Detection of Target Under Foliage



- **Tuesday, 11:00 to 12:25 in the Sidlaw Auditorium (Level +3)**
 - Forward Scattering Micro Radar Efficiency Analysis
 - SAR Tomography
 - MIMO Collision Avoidance Radar – Build and Test
- **Wednesday, 09:15 to 10:30 in the Sidlaw Auditorium (Level +3)**
 - InSb Technology for Integrated Passive Millimetre Wave Focal Plane Arrays
 - A Longer Range MIMO Body Scanner
 - 3D mapping of Buildings with SAPPHIRE
- **Wednesday, 11:15 to 12:30 in the Sidlaw Auditorium (Level +3)**
 - Passive Bistatic SAR Imaging using Galileo satellite
 - Multi-scan spatio-temporal discrimination for small target detection in clutter
 - Fabrication of a Multi-Octave Phased Array Aperture
- **Poster Displays in the Cromdale Hall (Level -2)**
 - throughout the Conference
- **Also, don't forget- in the Galloway Suite (Level 1)** 11am & 1:30pm today and 8:45am / 9.30am tomorrow
 - The MOD Centre for Defence Enterprise - Dr Helen Almey and Dr Nigel Chew
 - The UK Aerospace & Defence KTN - Dr Ruth Mallors and Sameer Savani
 - The MOD Technology Management Seminar - Mr John Yeaman (DE&S FBG)



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Research Theme Leader – Tony Kinghorn
Dstl Knowledge Integrator – Dr Iain Anderson

EMRS-DTC Research Director – Prof Keith Lewis
EMRS-DTC Consortium- Dr Andy Stove, Dr Philip Fentem