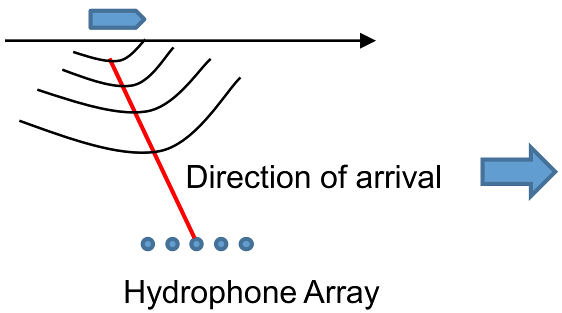
UDRC Demonstrations

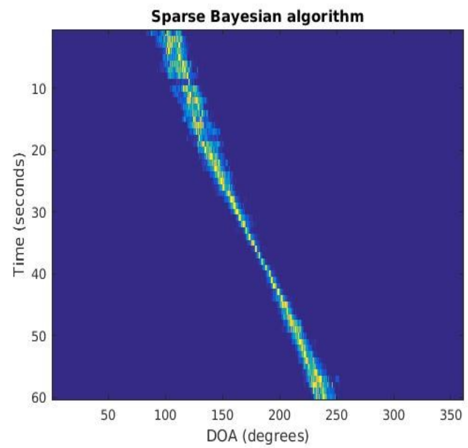
[dstl]
EPSRC
Engineering and Physical Sciences Research Council

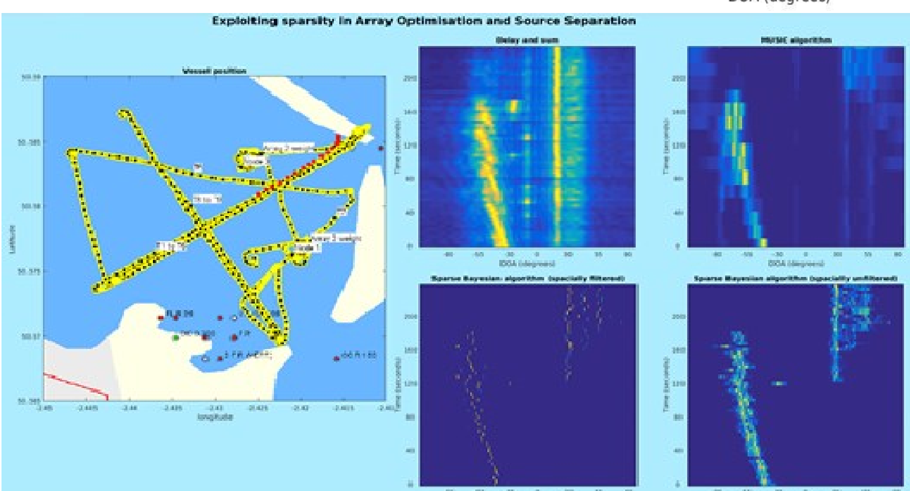
Exploiting Sparsity in Array Optimisation, Source Separation and Tracking

Wenwu Wang and Mark Barnard
University of Surrey

We demonstrate for hydrophone array applications, but the methods are general and can be used for other sensor arrays (such as radar and in-air acoustics).







Reducing Cost

Reducing the number of sensors, whilst preserving performance

Increased Reliability

Optimising performance of damaged arrays

Improved Performance

Reduce the effect of interfering sources and improve detection of weak sources

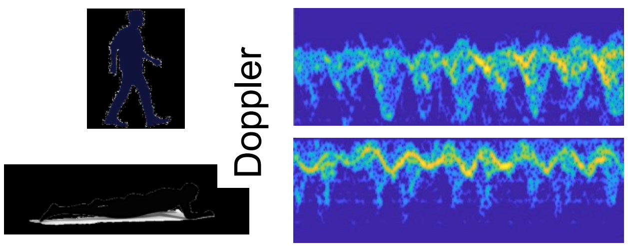
University Defence Research Collaboration (UDRC)
Signal Processing in a Networked Battlespace

Signal Processing Solutions for Advanced ATR and Co-Radar

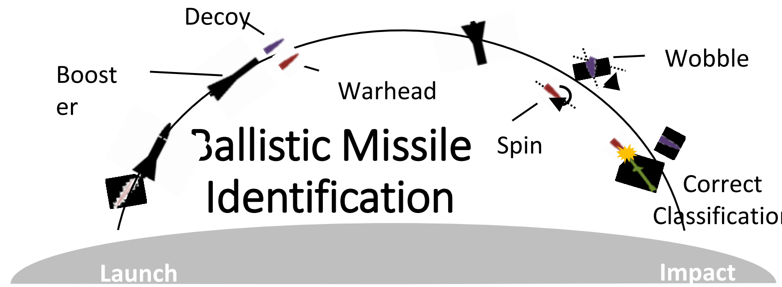
John Soraghan, Carmine Clemente, Christos Ilioudis, Ian Proudler
Department of Electronic and Electrical Engineering, University of Strathclyde

Demo 1: Micro-Doppler (mD) ATR

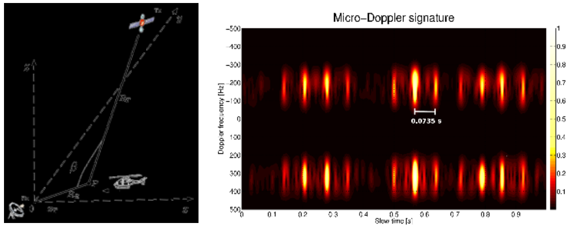
Real time demonstrator (video) using Raspberry PI to classify between four different classes: **Individual Walking and Running**, **Group Walking and Running**.



Time



GNSS Applications



Demo 2: Communicating Radar (Co-Radar)

Demonstrator of a **Real-time co-radar system** that simultaneously transmits information while sensing the radar micro-Doppler return from a moving target.

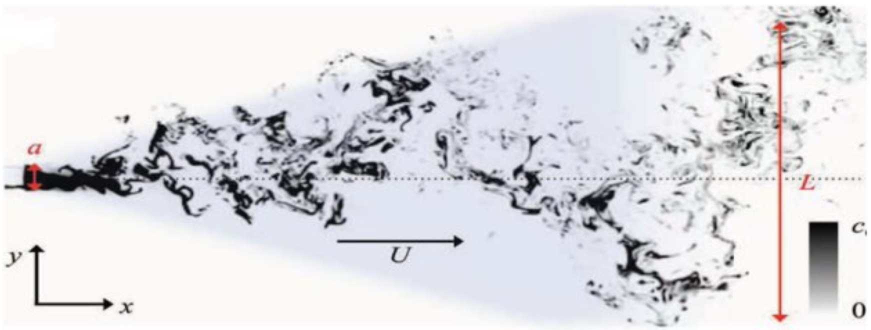
A family of **novel radar waveforms** that embeds communication data while keeping the good “Radar properties” of a **LFM pulse**.

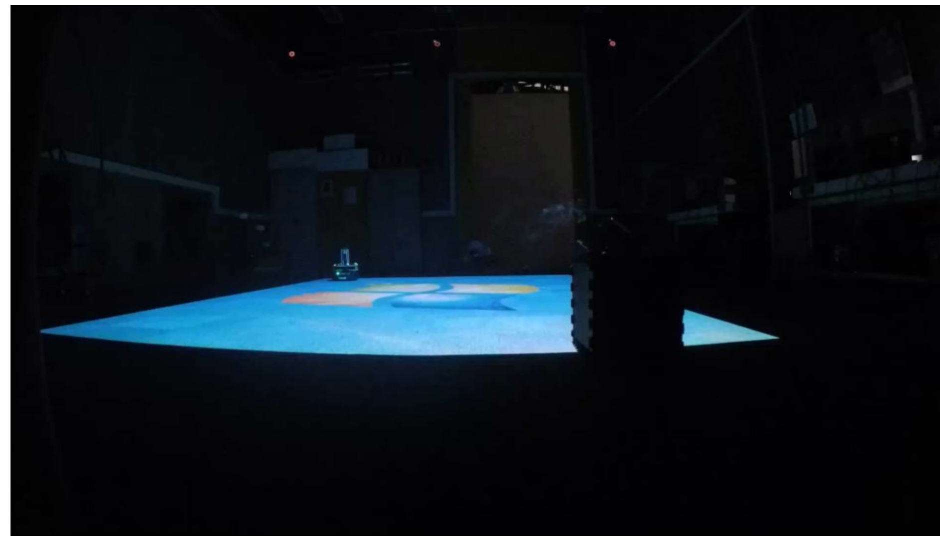
Advantages

Reduced Resource Requirements; Smaller Weight and Size; Lower Power.

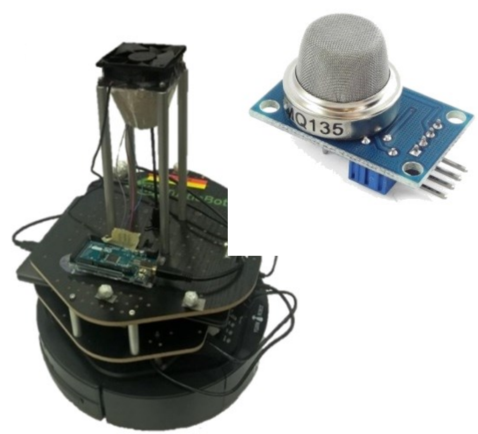
Autonomous Search for Hazardous Airborne Release with Mobile Robots

Michael Hutchison, Cunjia Liu and Wen-Hua Chen
Department of Aeronautical and Automotive Engineering, Loughborough University





- **Bayesian inference** – a probabilistic method to estimate the source parameters (location, emission rate)
- **Information based planning** – to guide the robot.



Signal Processing and Game Theoretic Methods for Multi-Target Tracking

- Low complexity signal processing methods for tracking multiple targets.
- A Kalman-gain aided sequential Monte Carlo probability hypothesis density filter (KG-SMC-PHD) filter for target-state-estimates.
- A formal mathematical framework known as game theory is introduced for target state-estimate-to-track associations.

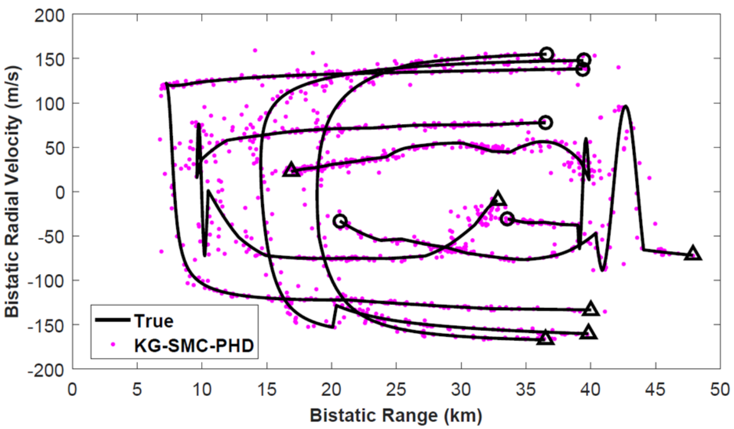


Figure 3: The true flight paths and the KG-SMC-PHD filter estimates.

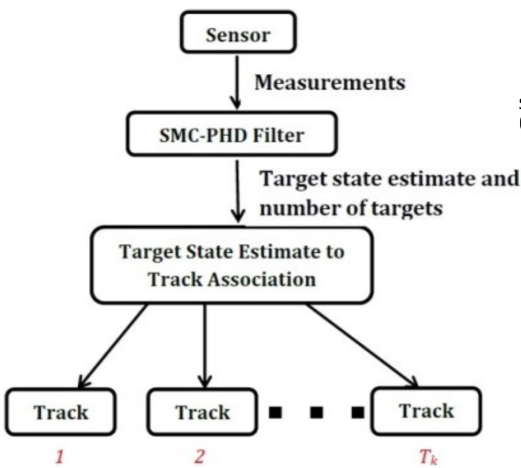


Figure 1: Various stages of the tracking and data association process.

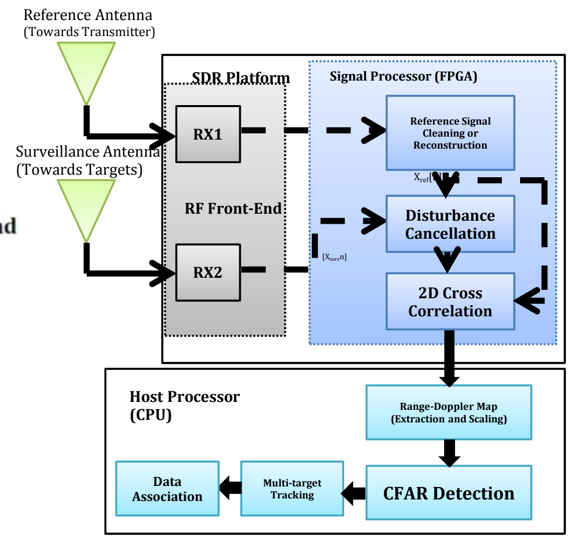


Figure 2: Passive bi-static radar receiver architecture.

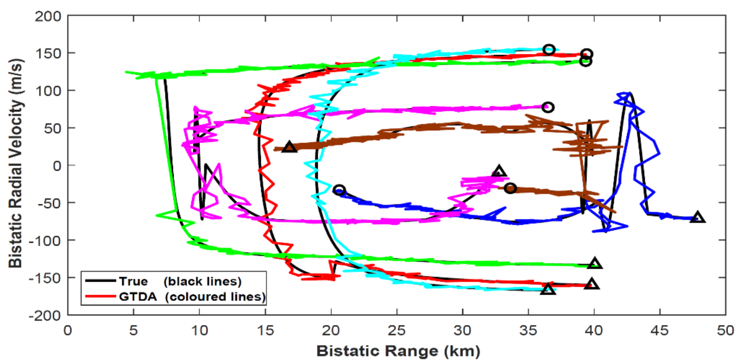
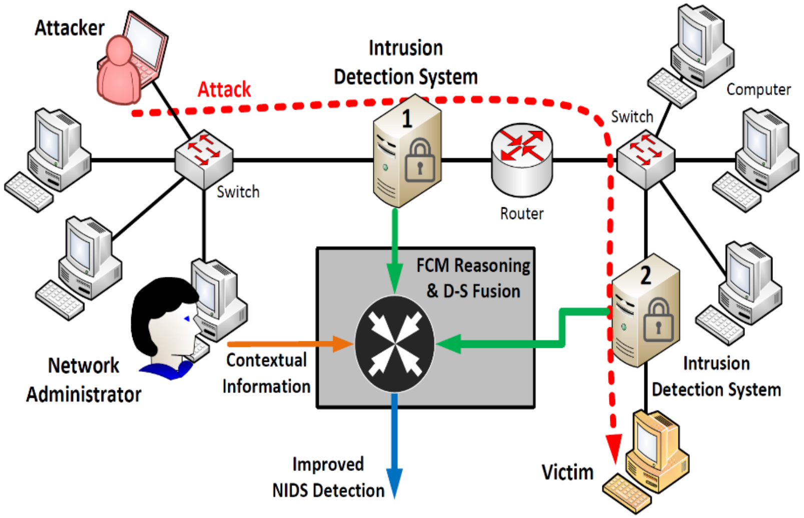
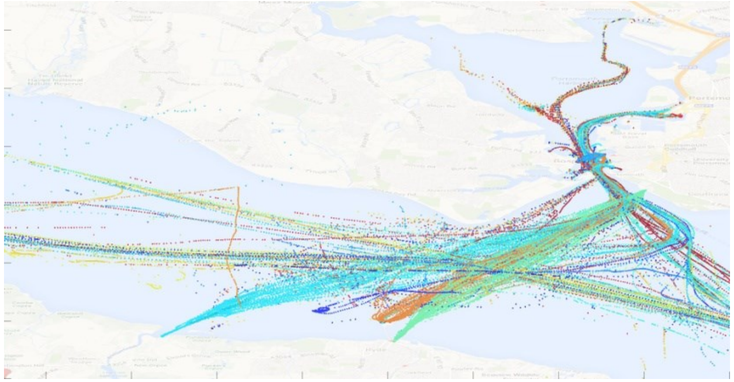


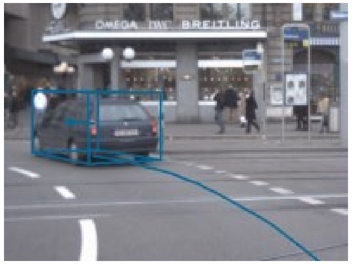
Figure 4: The game-theoretic target state estimate to track association

Anomaly Detection





Behaviour of Shipping
Cemre Zor & Josef Kittler



Cyber Defence
Francisco Aparicio-Navarro & Jonathon Chambers

THALES

Activity Recognition from Video
Ioannis Kaloskampis & Yulia Hicks

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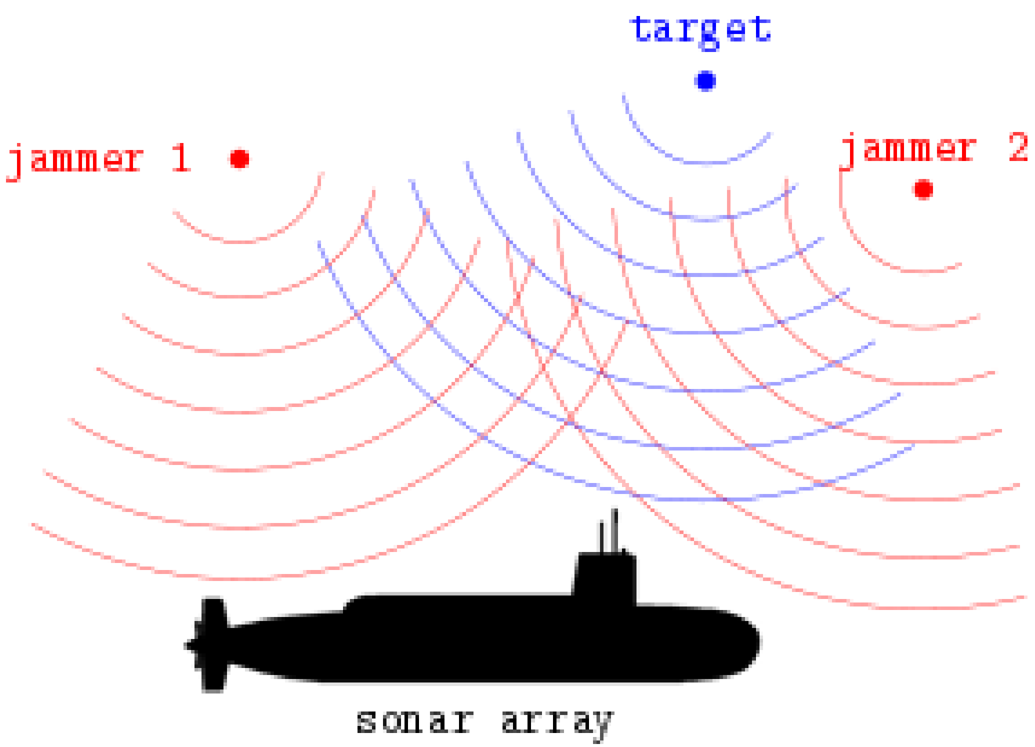
High Performance Broadband Sensor Array Processing

Keith Thompson, Stephan Weiss and Ian Proudler

- Techniques to enable novel and computationally efficient algorithms for broadband sensor array processing;
- Broadband signal can extend over several octaves;
- Potential exploitation in Sonar, Radar, EW domains;
- Demo applications in passive sonar - angle of arrival estimation and broadband beamforming.



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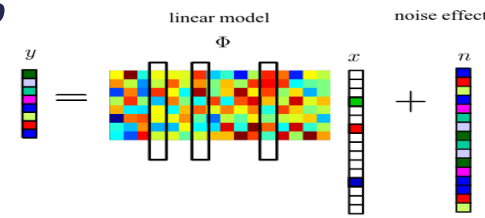
Sparse Signal Modelling for Efficient Sensing and Imaging

Mehrdad Yaghoobi, Mike Davies
Di Wu and Cecile Cheno

- **Sparse Approximation**: y is the signal of interest.
- **Compressed Sensing**: x is the sensing signal.



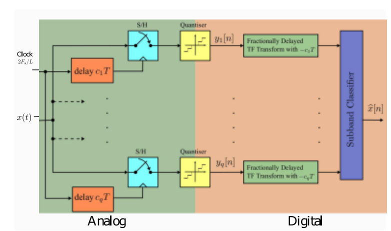
1. Raman Spectroscopy for Complex Mixture Analysis:

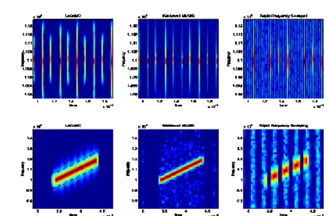
(Mehrdad Yaghoobi) A new spectral mixture analysis method for the detection of **hazardous** mixture materials.

www.defenceimagery.mod.uk

2. Ultra Wideband Radar Electronic Surveillance:

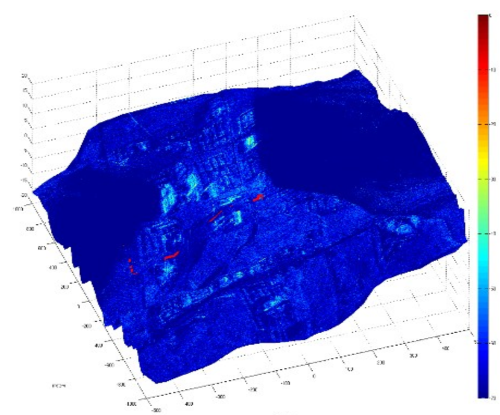
(Mike Davies) A novel low cost and SWaP multichannel ES system for current and future surveillance

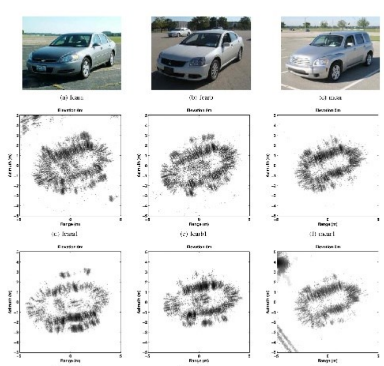




3. SAR Imaging and Target Characterization with Sensor Constraints:

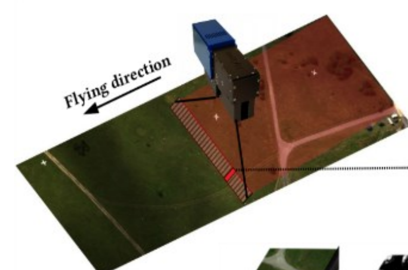
(Di Wu) Sparsity base SAR processing for target identification and state estimation.

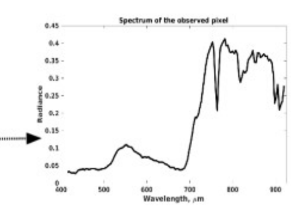


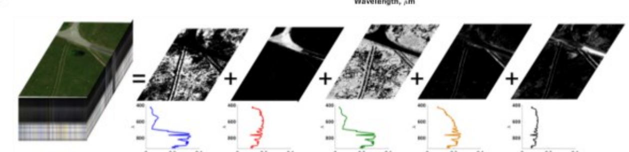


4. High-resolution Hyperspectral Anomaly Detection and Target Identification:

(Cecile Chenot) Spectral unmixing for the detection of unknown materials and/or localisation of specific known targets.

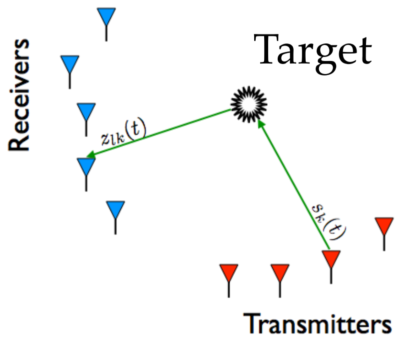


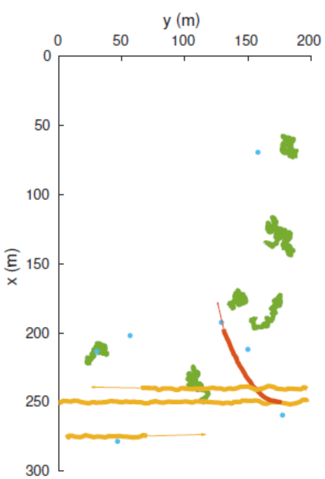


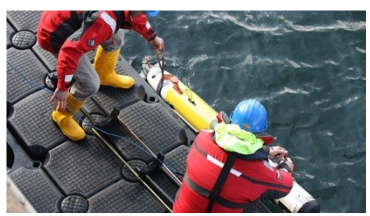


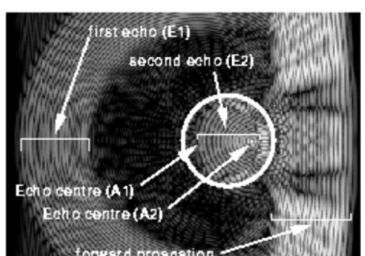
Underwater sensing: New architectures and waveforms for better characterisation of complex subsea environments

Yvan Petillot



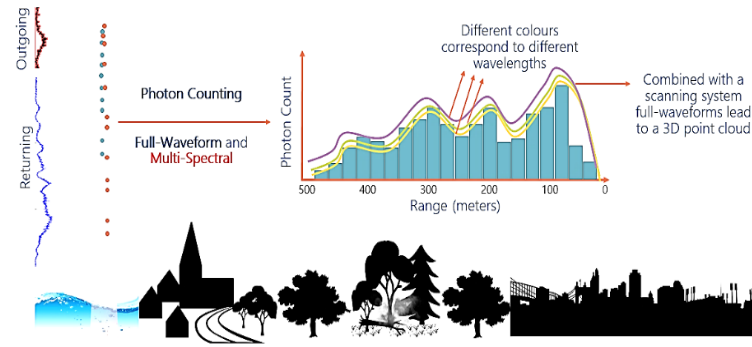


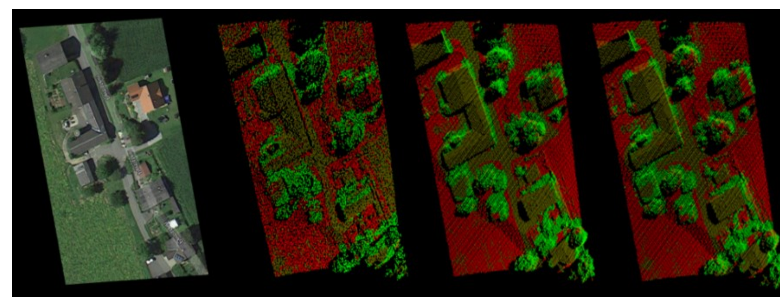




Anomaly detection and object recognition using hyperspectral Lidar

Andrew Wallace

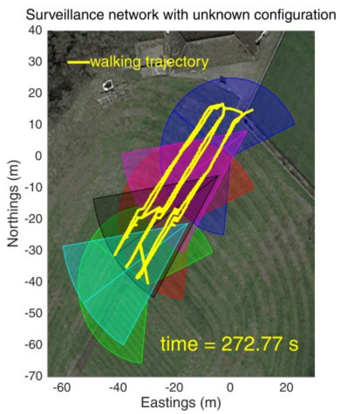


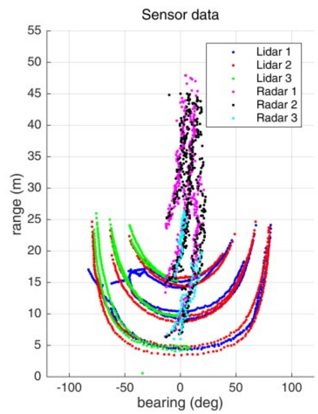


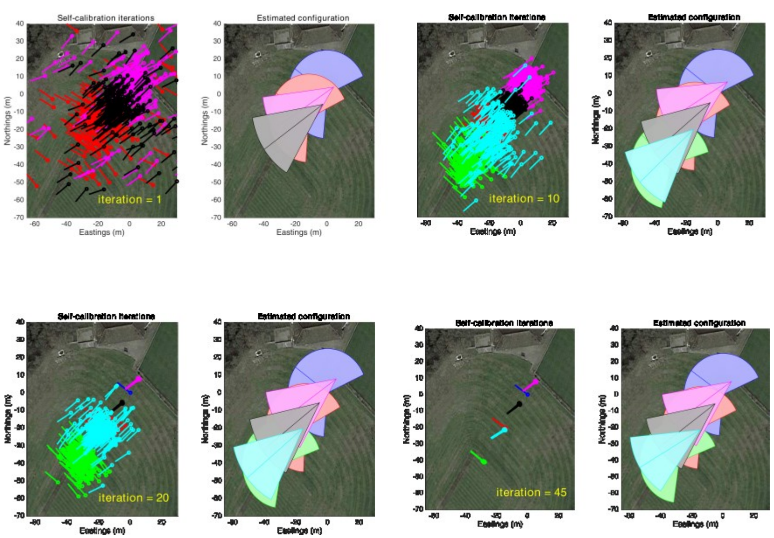
Enabling opportunistic self-calibration of sensor fusion networks

Uney, Mulgrew, Clark

CUBICA TECHNOLOGY



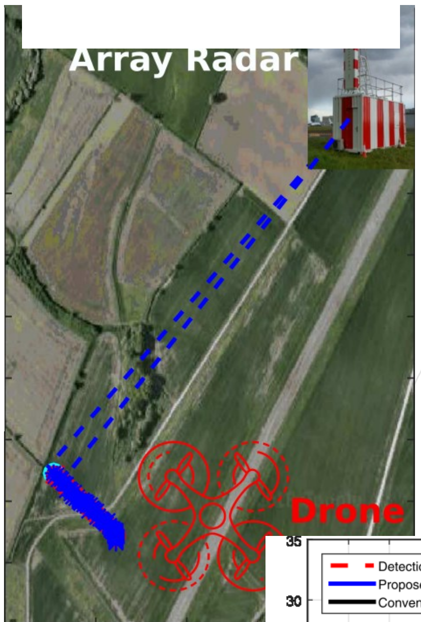


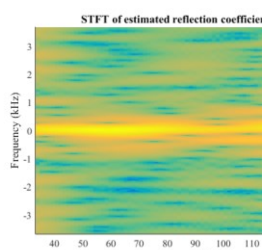


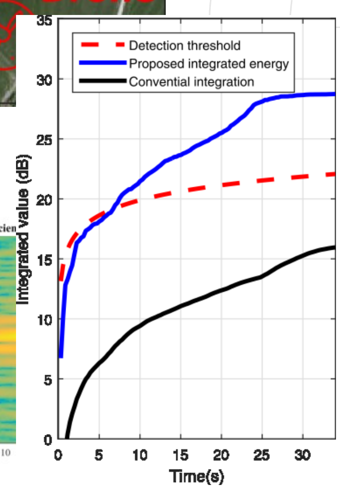
Reliable detection & characterisation of dim targets via TBD

Kir

AVEILLANT

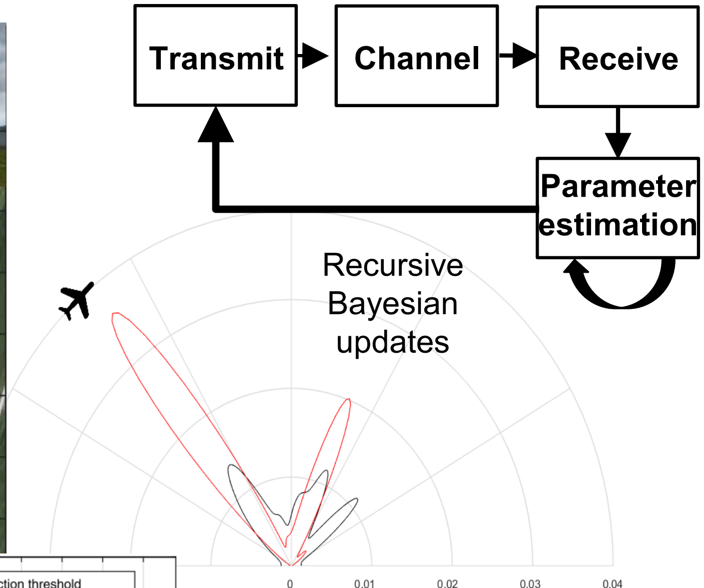


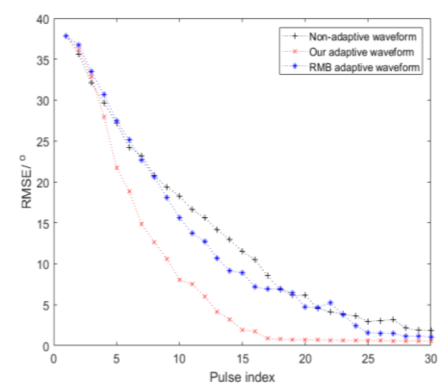




Adaptive Waveform Design for MIMO Active Sensing Systems

Herbert, Hopgood, Mulgrew





Contextual Anomaly Detection

Neil Robertson and Alessandro Borgia

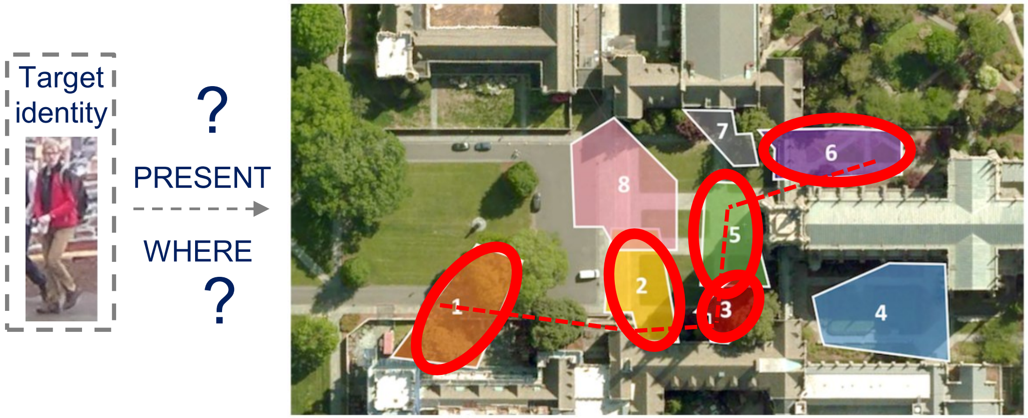
OPERATIONAL CAPABILITIES:

- Classify behaviour as safe vs. threatening
- Make on-line predictions about future behaviour
- Fast clustering allow us to deal with large datasets and maintain accuracy

Person of interest tracking by continuous re-identifications

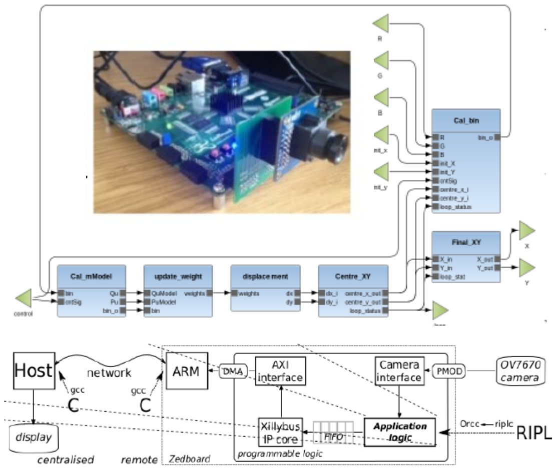
OPERATIONAL CAPABILITIES:

- Tracking in scenarios with sparse input, unconstrained topology, distributed processing units
- Automatic parsing of CCTV footage
- Tracks prediction by generative models
- Enabling anomaly detection applications

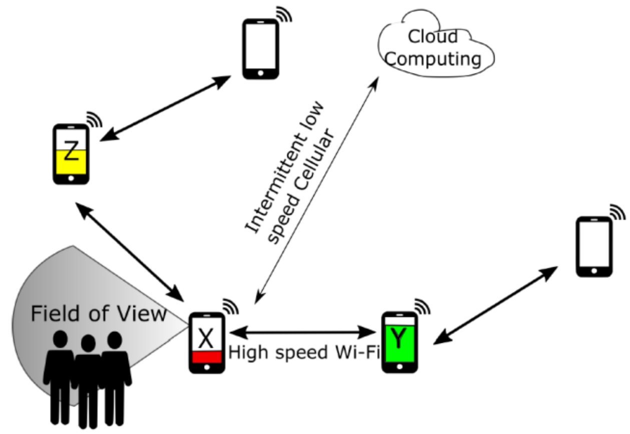


Network of non-overlapping cameras (long occlusions)

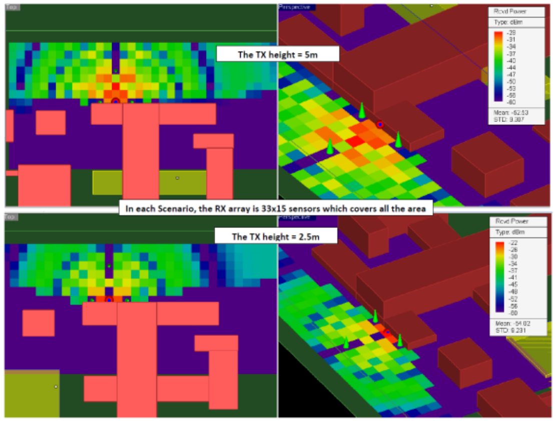
Efficient Computation of Complex Signal Processing Algorithms



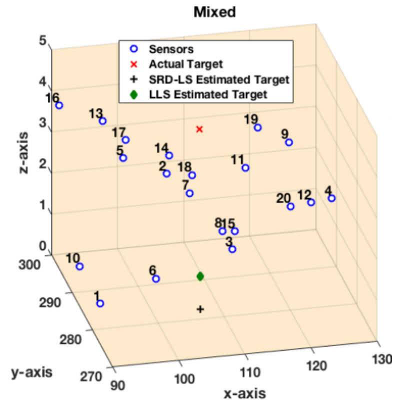
Paulo Garcia: Power-aware design of signal and image processing



Saurav Sthapit: Computation offloading in sensor networks



Loukianos Spyrou: MASNET monitoring of radio signals



Heba Shoukry: MASNET localisation of radio signals