

UDRC Communication and Engagement

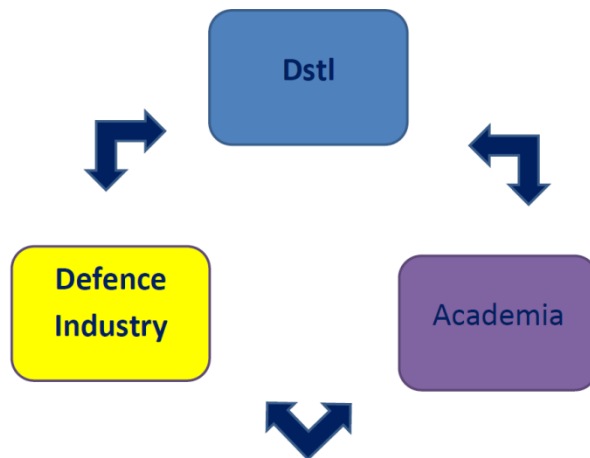
Janet Forbes,
UDRC Project Manager

4th December 2013



Communication and Engagement

- Two-way communication of research through digital media and engagement activities
 - Strengthen the Research Collaboration
 - Creation of links with researchers and defence stakeholders
 - Allow a pull-through of innovations for future exploitation



Coordination

- Website www.mod-udrc.org
- Industrial Affiliation Group
- Sensor Signal Processing for Defence (SSPD) Conference Series
- Summer Schools
- Themed Meetings
- Industrial Days
- UDRC Launch



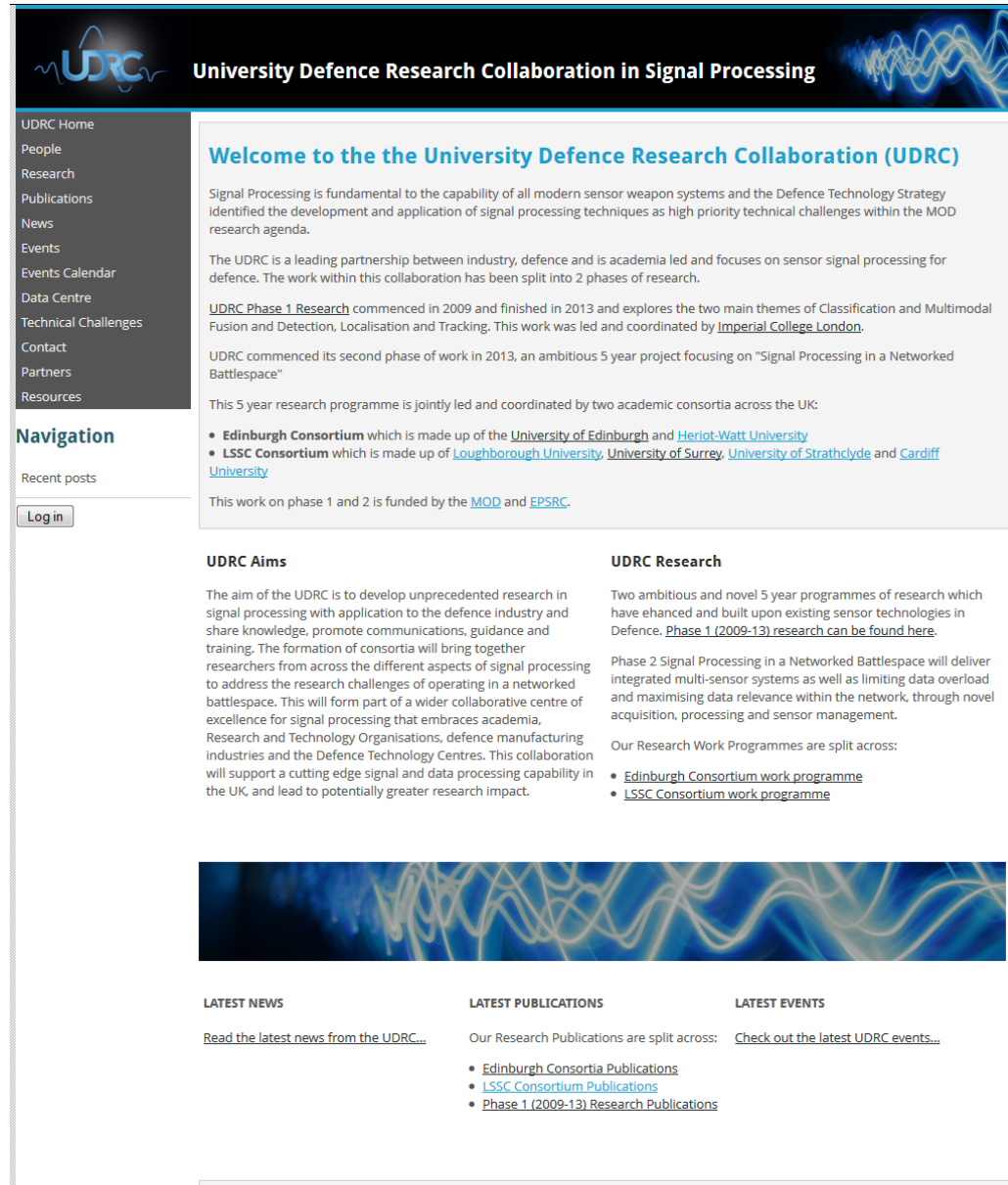
Website

www.mod-udrc.org

- Research
- People
- Calendar
- Events
- News
- Data area

Next

- Publications
- Resources
- Data



The screenshot shows the UDRC website homepage. At the top, there is a navigation menu with links for UDRC Home, People, Research, Publications, News, Events, Events Calendar, Data Centre, Technical Challenges, Contact, Partners, and Resources. Below the menu is a 'Navigation' section with a 'Log in' button and 'Recent posts'. The main content area features a 'Welcome to the the University Defence Research Collaboration (UDRC)' section, followed by 'UDRC Aims' and 'UDRC Research' sections. The 'LATEST NEWS', 'LATEST PUBLICATIONS', and 'LATEST EVENTS' sections are located at the bottom of the page.

UDRC Home
People
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Publications
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Events Calendar
Data Centre
Technical Challenges
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Navigation
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[Log in](#)

Welcome to the the University Defence Research Collaboration (UDRC)

Signal Processing is fundamental to the capability of all modern sensor weapon systems and the Defence Technology Strategy identified the development and application of signal processing techniques as high priority technical challenges within the MOD research agenda.

The UDRC is a leading partnership between industry, defence and academia led and focuses on sensor signal processing for defence. The work within this collaboration has been split into 2 phases of research.

UDRC Phase 1 Research commenced in 2009 and finished in 2013 and explores the two main themes of Classification and Multimodal Fusion and Detection, Localisation and Tracking. This work was led and coordinated by [Imperial College London](#).

UDRC commenced its second phase of work in 2013, an ambitious 5 year project focusing on "Signal Processing in a Networked Battlespace"

This 5 year research programme is jointly led and coordinated by two academic consortia across the UK:

- **Edinburgh Consortium** which is made up of the [University of Edinburgh](#) and [Heriot-Watt University](#)
- **LSSC Consortium** which is made up of [Loughborough University](#), [University of Surrey](#), [University of Strathclyde](#) and [Cardiff University](#)

This work on phase 1 and 2 is funded by the [MOD](#) and [EPSRC](#).

UDRC Aims

The aim of the UDRC is to develop unprecedented research in signal processing with application to the defence industry and share knowledge, promote communications, guidance and training. The formation of consortia will bring together researchers from across the different aspects of signal processing to address the research challenges of operating in a networked battlespace. This will form part of a wider collaborative centre of excellence for signal processing that embraces academia, Research and Technology Organisations, defence manufacturing industries and the Defence Technology Centres. This collaboration will support a cutting edge signal and data processing capability in the UK, and lead to potentially greater research impact.

UDRC Research

Two ambitious and novel 5 year programmes of research which have enhanced and built upon existing sensor technologies in Defence. [Phase 1 \(2009-13\) research can be found here.](#)

Phase 2 Signal Processing in a Networked Battlespace will deliver integrated multi-sensor systems as well as limiting data overload and maximising data relevance within the network, through novel acquisition, processing and sensor management.

Our Research Work Programmes are split across:

- [Edinburgh Consortium work programme](#)
- [LSSC Consortium work programme](#)

LATEST NEWS

Read the [latest news from the UDRC...](#)

LATEST PUBLICATIONS

Our Research Publications are split across: [Check out the latest UDRC events...](#)

- [Edinburgh Consortia Publications](#)
- [LSSC Consortium Publications](#)
- [Phase 1 \(2009-13\) Research Publications](#)

LATEST EVENTS

Industrial Affiliates

Mailing List - Receiving updates on news and events from UDRC

- Posters
- Publications
- UDRC Events
- Related Events
- Annual Reports
- Data
- Find an expert
- Come and talk with us



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

L_WPS: Low Complexity Algorithms and Efficient Implementation
WP Leaders: Stephen Weiss (University of Strathclyde), Ian Proutier (Loughborough University)
Researcher: K.Thompson (University of Strathclyde)

Aim: To develop novel paradigms and implementation strategies for a range of complex signal processing algorithms operating in a networked environment. Support all WPs in development of efficient methods and hardware implementations.
Scientificallly Possible → Technicallly Feasible

L_WPS.1 Data reduction and distributed processing

Data Reduction
Lower dimensional representation of data can lead to significant cost reduction. This work will exploit both data dependent and independent techniques (e.g. freq. domain, sub-band or subspace-based processing, pruning of sensor data) and demonstrate low-cost algorithms. Areas of study:
• Polynomial decompositions leading to sparse representations through data-dependent optimal transformations (e.g. Kuhlman-Loeve transforms) for dimensionality reduction in featuremaps.

Distributed Processing
For a networked environment, the efficient organisation of algorithms across a distributed processing platform will be considered (e.g. access and/or constraints on communications bandwidth between nodes). Areas of study:
• Parallel implementations of linear algebra functions and distributed processing methods (e.g. systolic array design, IP core implementations, vector-oblivious methods)
• Statistical signal processing methods (e.g. Bayesian Networks) will be utilised to map algorithms to distributed processors

Current Objectives & Progress
Currently investigating the efficient implementation of the SBPD algorithm [1] to perform Polynomial Eigenvalue Decomposition (PEVD) for Blindfold Detection of Aerial Operations. SBPD has proved costly to implement, with complexity rising quickly with the log dimension of any polynomial matrix.
• Matlab Toolkits of optimised software code in development
• Approximate methods that exploit the growing sparsity of the polynomial matrix upon repeated shift and fraction operations (Shifting) These 'hint' methods are aimed at limiting the growth of the overall matrix to enable efficient signal processing
• Integration of SBPD with novel oversampled sub-band decomposition methods in order to investigate the concept of to split coherence between sub-bands, but reduce spectral dynamics within a sub-band, resulting in shorter tails and cross-operations
• Distributed Beamforming – investigations are underway into distributed beamforming techniques, see [2], specifically on how Station Non-orthog [3] can be exploited for message passing between nodes
• Distributed Decomposition component of Coherent sensor nodes presented at ISIP 2013 [4]. This application used a fractional array (sparse) formation of Cubesats to reproduce large antenna behaviour whilst avoiding complexity growth in distributed architectures.

References
[1] J. D. Van Wazer, "PC Sparse T-Convolution and Fractional Eigenvalue Algorithms for Polynomial Eigenvalue Decomposition (PEVD) for Blindfold Detection of Aerial Operations (BDAO)", in Proc. 2013 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2013, pp. 1-5.
[2] J. D. Van Wazer, "Efficient Implementation of Polynomial Eigenvalue Decomposition (PEVD) for Blindfold Detection of Aerial Operations (BDAO)", in Proc. 2013 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2013, pp. 1-5.
[3] J. D. Van Wazer, "Efficient Implementation of Polynomial Eigenvalue Decomposition (PEVD) for Blindfold Detection of Aerial Operations (BDAO)", in Proc. 2013 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2013, pp. 1-5.
[4] J. D. Van Wazer, "Efficient Implementation of Polynomial Eigenvalue Decomposition (PEVD) for Blindfold Detection of Aerial Operations (BDAO)", in Proc. 2013 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2013, pp. 1-5.

Links to other WPs
Collaborative research and active engagement with all other WPs is to result in generic efficient approaches to tackle common themes:
• Dealing with High-dimensional array data
• Identify Parallelization & Distribution Opportunities of Algorithms
• Efficient Frequency Analysis
• Developing Efficient Matlab Toolboxes
• Application-specific low-level hardware implementations

References
[1] J. D. Van Wazer, "PC Sparse T-Convolution and Fractional Eigenvalue Algorithms for Polynomial Eigenvalue Decomposition (PEVD) for Blindfold Detection of Aerial Operations (BDAO)", in Proc. 2013 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2013, pp. 1-5.
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Logos: UDR, dstl, EPSRC

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

Context-driven Behaviour Monitoring and Anomaly Detection

Prof. Rolf Saecker, Puneet Chhabra, Eleonora DiCaro, James Hogwood, Neil Robertson, Andrew Wallace

Convoy monitoring from an airborne platform

Using electro-optic sensor behaviour and PA in audio-video features to detect subtle anomalies from normal context models, we can detect, by feeding back algorithms.

Convoy behaviour can be monitored autonomously from sensorised platforms.

- Spatial and social context allow for better behavioural inference, facilitating tracking in complex environments. For example:
 - Typical convoy response to a road block
 - Simplified tracking of 'follow the leader' manoeuvre
- Social context allows subtle anomalies to be detected (e.g. 'odd' convoy approaching)

Enhanced situation awareness

- A vehicle with mounted optics sensor system (Lockheed Martin)
- Detection of subtle anomalies at checkpoints and public places. For example:
 - Abnormal 'gazing' at objects, people or cameras

Research objectives

- Use advanced social models (e.g. gazing, scene context) to improve group tracking in crowded scenes
- Detect social anomalies, with defence, homeland, and retail security applications
- Utilise other modality data features (e.g. audio) to detect and re-enforce anomaly detection from non-visual cues

Context-driven behaviour monitoring and anomaly detection is a key research objective of the UDRC. The project has proven its value in several scenarios, including the detection of subtle anomalies at checkpoints and public places. For example, abnormal 'gazing' at objects, people or cameras. The project also aims to enhance situation awareness by using advanced social models (e.g. gazing, scene context) to improve group tracking in crowded scenes. The project will also detect social anomalies, with defence, homeland, and retail security applications. Finally, the project will utilise other modality data features (e.g. audio) to detect and re-enforce anomaly detection from non-visual cues.

Logos: UDR, dstl, EPSRC

Sensor Signal Processing for Defence Conference 2014

www.sspdconference.org

Location: Edinburgh

Date: 8th and 9th September 2014

To bring together researchers from
academia, industry and
government organisations

To discuss the latest developments in
Signal Processing for Defence.

*Technical sponsors: Signal
Processing Society and
proceedings will be indexed in
IEEE XPLORE*

Important Dates

Submission of Papers Deadline:
4th April 2014

Notification of Paper Acceptance
Due: 4th June
2014

Final version of paper due: 4th
August 2014



Summer School

Location : Postgraduate Centre, Heriot-Watt University, Edinburgh

Week commencing 23rd June 2014

This course is aimed at researchers in defence, industry, government and academia with interests in **Signal Processing for Defence**.

- Improve knowledge
- Theoretical learning into practical engineering applications.
- Focal point for research in Signal Processing for Defence
- Stimulate new collaborations

Finite Set Statistics Summer School

Why Finite Set Statistics?

Used for multi-object Bayesian estimation (modelling and derivation of multi sensor/multi-target detection and tracking algorithms)

The Courses Covered:

- Concepts in probability theory
- Stochastic filtering
- Functional analysis
- Variational calculus
- Point process theory
- Multi-object estimation
- Practical implementations with sequential Monte Carlo and Gaussian mixture techniques



UK and USA Editions

- July and August 2013
- 5 days

Heriot Watt University/ Kirtland USAF Base
Academic/Defence/Industry attendees

- Excellent feedback and interest in more Summer Schools.
- Attendees all reported an enhanced understanding.

Themed Meetings

Lively technical meetings/workshops

- Source Separation and Sparsity (held Oct 2013)
- Uncertainty and anomaly detection (May 2014)
- Autonomous systems and processing (Nov 2014)
- Hardware and implementation (Feb 2015)
- Exploitation (Nov 2015)



Industrial Days

- Annual
- First event scheduled 27th June 2014
- Showcase work from UDRC
- Talks, Posters, Demos
- Opportunity to discuss research collaborations



UDRC Calendar 2014

2014	UDRC Events
January	
February	
March	
April	
May	UDRC Themed Meeting:-Uncertainty and anomaly detection - 28/5/14
June	UDRC Summer School - 23/6/14 to 27/6/14 UDRC Industrial Day - 27/6/14
July	
August	
September	SSPD Conference – 8/9/14 & 9/9/14
October	
November	UDRC Themed Meeting:- Autonomous systems and signal processing - date tbc.
December	

UDRC Launch

- Posters/Presentations can be viewed at:

www.mod-udrc.org/events/20131204-the-sensor-signal-processing-for-defence-launch

- Evaluation forms
- Any questions/queries:

Janet Forbes: 0131 650 5706

janet.forbes@ed.ac.uk

