

University Defence Research Collaboration in Signal Processing

[a partnership between government, industry and academia]

Prof. James Hopgood
University of Edinburgh



Welcome to UDRC-EURASIP Summer School 2023

- 9th Summer School (since 2013)
- 60 people registered over 4 days
- 22 Different organisations
- Funded by EPSRC and Dstl

Experts from:

- University of Edinburgh
- Heriot-Watt University
- University of Strathclyde
- Leonardo
- Dstl

The UDRC

Collaborative Centre of Excellence for Signal Processing

Aims

- World-class research
- Long-term sustainable skills
- Community of practice

Approach

- Joint funding with EPSRC
- Dstl technical leadership
- Close, early engagement with industry



Fostering the signal processing community

Annual Conference

Educating the next generation

SSPD 2021
Sensor Signal Processing for Defence Conference

Important Dates:
Submission of Papers: Extended to 3
Notification of Paper Acceptance: 14
Final version of Paper Due: 30 July 2021
Date of conference: 14 to 18 Sep
Location: Hybrid Conference - Online and in-person

SSPD 2023
Sensor Signal Processing for Defence Conference

Important Dates:
Submission of Papers: 16th April 2023 **Extended deadline 7th May 2023**
Notification of Paper Acceptance: 30th June 2023
Final version of Paper Due: 30th July 2023
Date of conference: 12 to 13 September 2023
Royal College of Physicians Edinburgh

International Conference in Sensor Signal Processing for Defence
The Signal Processing for Defence Conference is an academic and industry conference for researchers and engineers in the field of signal processing for defence. The conference is held annually in Edinburgh, Scotland, and is the largest of its kind in the world.

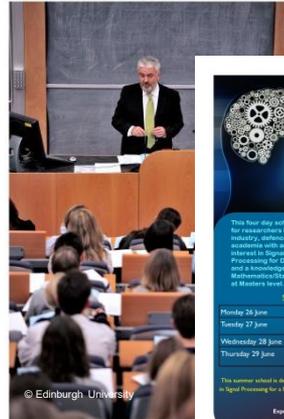
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International Conference in Sensor Signal Processing for Defence: From Sensor to Decision
Signal processing for defence conference is organized by the University Defence Research Collaboration (UDRC) in Signal Processing, 55/57, 7/22 Arms to bring together researchers from academia, industry and government organisations concerned with Signal Processing for Defence.

Papers are selected from the following areas:
Air or Space Processing
Image Processing
Radar Processing
Passive Sensor and Analysis
Multimodal Signal Processing
Machine Learning
Signal Acquisition and Sensor Management
Monitoring and Intelligence (MINT)
Deep Learning, Machine Learning

Information/Data Analysis
Data Fusion
Source Separation
Anomaly Detection
Detection and Classification
Low SNR/WAY & Fewer Solutions
Target Detection and Identification
Face-to-Face Learning

All submitted papers will be peer reviewed. Technical sponsorship is provided by the IEE Signal Processing Society and proceedings will be submitted to the Xplore Digital Library.
www.spsconference.org



UDRC Summer School
26 - 29 June, University of Edinburgh

IMPORTANT DATES
• Application Open: 1 January 2023
• Deadline for Application: 17 March 2023
• Notification of Application: 31 March 2023

This four day school is for researchers in industry, defence and academia with an interest in Signal Processing for Defence and a knowledge of Mathematics/Statistics at Masters level.

Summer School Programme

Monday 26 June	Statistical Signal Processing
Tuesday 27 June	Tracking
Wednesday 28 June	Pattern Recognition and Classification
Thursday 29 June	Source Separation

This summer school is delivered under the University Defence Research Collaboration in Signal Processing for Defence and is funded by EPSRC and Dstl.
Expression of interest - email janet.fletcher@dstl.ac.uk
More information - www.mrod-udrc.org.uk (2023 summer school)

UDRC Summer School
19-22 June, 2023
University of Edinburgh

IMPORTANT DATES
• Application Open: 1 January 2023
• Deadline for Application: 17 March 2023
• Notification of Application: 31 March 2023

This four day school is for researchers in industry, defence and academia with an interest in Signal Processing for Defence and a knowledge of Mathematics/Statistics at Masters level.

Summer School Programme

Monday 19 June	Statistical Signal Processing
Tuesday 20 June	Sensing and Tracking
Wednesday 21 June	Machine Learning
Thursday 22 June	Source Separation and Beamforming

www.mrod-udrc.org

This summer school is delivered under the University Defence Research Collaboration (UDRC) in Signal Processing in the Information Age and is funded by EPSRC and Dstl.

Website

University Defence Research Collaboration in Signal Processing

Welcome to the the University Defence Research Collaboration (UDRC)

The UDRC develops research in signal processing with application to the defence industry. It is an academia led partnership between industry and defence.

The work within this collaboration has been split into 2 phases of research. UDRC commenced its second phase of work in 2013, an ambitious 5 year project focusing on "Signal Processing in a Networked Battlespace". This research programme is jointly led and coordinated by two academic consortia across the UK:

Edinburgh Consortium

- University of Edinburgh
- Heriot-Watt University

LSRC Consortium

- Loughborough University
- University of Surrey
- University of Warwick
- Cardiff University

This work is funded by the MOD and EPSRC.

Latest News | **Recent Publications** | **Upcoming Events**

Themed meetings

- Quantum Signal Processing
- Algorithm Implementation and Low SWAP Challenges
- Multiple Object Tracking and Decentralised Processing
- Autonomous Systems
- Signal Processing in the Underwater Environment:
- Signal Processing for the Electromagnetic Environment
- Imaging through Obscure Media
- Machine Learning and Deep Learning
- Scalable Signal Processing with Bayesian Graphical Models

Sensor Signal Processing for Defence Conference 2023

Registration is open and the conference
will be an in person Conference in
Edinburgh

www.sspdconference.org



SSPD 2023

Sensor Signal Processing for Defence Conference

Important Dates:
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International Conference in Sensor Signal Processing for Defence: from Sensor to Decision

Signal Processing for Defence Conferences is organised by the University Defence Research Collaboration (UDRC) in Signal Processing. SSPD 2023 aims to bring together researchers from academia, industry and government organisations interested in Signal Processing for Defence.

Papers are selected from the following areas:

- Array Signal Processing
- Image Processing
- Radar, Sensor and Acoustics
- Multimodal Signal Processing
- Multi-Target Tracking
- Signal Acquisition and Sensor Management
- Multiple-input and multiple-output (MIMO)
- Deep Learning, Machine Learning
- Information/Data Analysis
- Data Fusion
- Source Separation
- Anomaly Detection
- Distributed Signal Processing
- Low-SNR Weight & Power Solutions
- Target Detection and Identification
- Electro-Optic Sensing

All submitted papers will be peer reviewed. Technical sponsorship is provided by the IEEE Signal Processing Society and proceedings will be submitted to the Xplore Digital Library.

www.sspdconference.org



Summer School Programme

Lectures – all week in this room

2 networking events

- BBQ this evening – 5:30pm
- Summer School Dinner on Wednesday evening – 7:30pm

Certificate of attendance

- Ask Janet

Evaluation Forms – please fill in

Evaluation Form



Statistical Signal Processing – Monday 19th June 2023

9:00 to 10:30 Introduction: Introducing exemplar application areas that use statistical signal processing concepts, such as target localization, blind source separation, and other timely topics.

Probability and Random Variables: Axioms of probability and classic paradoxes; scalar and vector random variables; probability transformations and applications; statistical descriptors; central limit theorem.

Classical Estimation Theory: Basic concepts; properties of estimators; maximum likelihood; least squares. The theory will be linked to a “breakdown” of the localization problem.

James Hopgood, University of Edinburgh

10:30 to 11:00 Refreshments

11:00 to 12:30 Further Estimation Theory and Examples: Cramér–Rao lower bounds and Examples; Generative modelling, physical modelling, and Bayesian Estimation Theory.

Overview of Monte-Carlo Methods: Applications for integration and optimization, generating random variables, accept-reject and importance sampling, MCMC techniques.

James Hopgood, University of Edinburgh

12:30 to 13:30 Lunch

13:30 to 15:00 Random Processes: Ensembles, statistical descriptors; input-output system statistics; PSDs; Bayesian Recursions.

James Hopgood, University of Edinburgh

Expectation Propagation (EP) for Scalable Inverse Problems in Imaging: introduction to EP for approximate Bayesian inference, EP scalable solutions to different imaging problems and uncertainty quantification, EP application in low-light-level color imaging using single-photon avalanche diode (SPAD) detector arrays, EP application in turning SPAD arrays into depth-based neuromorphic cameras.

Dan Yao, Heriot-Watt University

15:00 to 15:30 Refreshments

15:30 to 17:00 Decision theory: Risk, optimal decisions, likelihood ratio test, connections with MAP and maximum likelihood estimation, types of errors, and Neyman-Pearson lemma.

João Mota, Heriot-Watt University

17:30 to 19:00 BBQ outside the Nucleus Building

Any Questions?