University Defence Research Collaboration in Signal Processing

[a partnership between government, industry and academia]

Prof. James Hopgood

University of Edinburgh

[dstl] The Science Inside

UKRI Engineering and Physical Sciences Research Council

UDRC

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

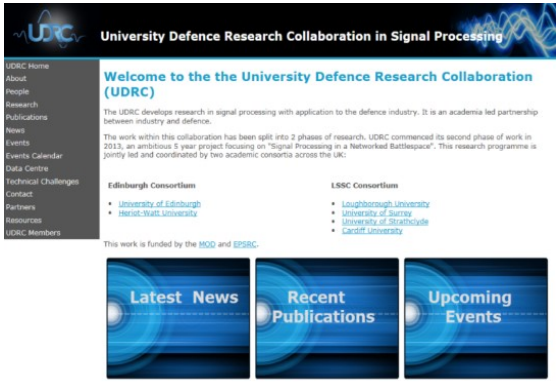
Approach

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

Fostering the signal processing community

Annual Conference

Website



Educating the next generation

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

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?