UDRC Summer School Programme – 27th June to 30th June 2016, University of Edinburgh

	Statistical Signal Processing Monday 27th June*	Tracking Tuesday 28th June	Pattern Recognition and Classification Wednesday 29th June**	Source Separation Thursday 30th June
08:30	Coffee	Coffee	Coffee	Coffee
09:00	**Introduction and Target Localisation:** Discussion of "target localisation" as an exemplar application forming the basis of the day. **Probability and Random Variables and Classical Estimation Theory:** Probability and some paradoxes; random variables; probability transformations; statistical descriptors; central limit theorem; Monte Carlo methods; generating random variables. Basic concepts of estimation theory; properties of estimators; Cramér–Rao lower bounds; maximum likelihood; linear and non-linear least squares. *James Hopgood, University of Edinburgh*	**Applications of multi-target tracking:** An overview of the range of different applications in need of solutions to multi-target tracking. *Daniel Clark, Heriot-Watt University*	**Introduction to pattern recognition and classification:** Basic concepts; pattern recognition problem; pattern recognition system; elements of statistical decision theory; parametric and nonparametric decision rules; kNN classifier: distance, similarity, reconstruction; similarity based classification; classification via sparse representation; classifier training and testing; classifier error estimation. *Josef Kittler, University of Surrey*	**Introduction to source separation:** Instantaneous and convolutive mixing models; block and sequential blind source separation algorithms; applications. *Wenwu Wang, University of Surrey*
10.00		**The Particle Filter:** A solution to the problem of Bayesian estimation for nonlinear dynamical and observation models. *Jose Franco, Heriot-Watt University*		**Principal component analysis (PCA):** Independent component analysis (ICA); independent vector analysis (IVA); algorithms and tutorial examples. *Mohsen Naqvi, Newcastle University*
11:00	Refreshments	Refreshments	Refreshments	Refreshments
11:30	**Introduction to Random Processes:** Ensembles, statistical descriptors; input-output statistical relationships; system identification; special representations; Wiener filtering; state-space models. *James Hopgood and Murat Uney, University of Edinburgh*	**Multi-object modelling for clutter processes:** An introduction on filter design using different underlying models for the clutter distribution. *Isabel Schlangen, Heriot-Watt University*	**Dimensionality reduction:** Principal component analysis; linear discriminant analysis; kernel implementation of PCA and LDA; kernel PCA and Kernel discriminant analysis; spectral regression KDA; multiple kernel fusion; feature selection; multiple classifiers. *Josef Kittler, University of Surrey*	**Convolutive source separation:** Exploiting signal properties; nonstationarity and sparsity; and deep learning algorithms and tutorial examples. *Wenwu Wang, University of Surrey*
13:00	Lunch	Lunch	Lunch	Lunch
14:00	**Adaptive Filtering and the Kalman Filter:** State-space models: introduction to adaptive signal processing; scalar Kalman filter. *Murat Uney, University of Edinburgh*	**Multi-object Filtering:** The PHD Filter and Gaussian mixture implementations. *Daniel Clark, Heriot-Watt University*	**Machine learning (support vector machines):** Linear discriminant functions: definition of convex set and convex functions; convex optimization; soft margin classifier; non-linear discriminant functions. *Sangarapillai Lambotharan, Loughborough University*	**Polynomial matrices and decompositions:** Tutorial examples. *Stephan Weiss, University of Strathclyde*
15:30	Refreshments	Refreshments	Refreshments	Refreshments
16:00 – 17:00	**Bayesian Estimation Theory and Closing Remarks:** Bayes theorem; removal of nuisance parameters (marginalisation); general linear model; priors; MAP estimates; Chapman-Kolgomorov equation (if time). *James Hopgood and Murat Uney, University of Edinburgh*	**Recent advances in multi-object estimation:** New methods for target classification and sensor management. *Emmanuel Delande, Heriot-Watt University*	**Deep learning - architectures, algorithms and applications:** Convolutional neural Networks; recurrent networks and LSTM; applications of deep learning in computer vision and natural language processing. *Fei Yan, University of Surrey*	**Beamforming and Source Separation Application Case Studies.** *Stephan Weiss, University of Strathclyde*

*Monday 27th June 2016 at 7pm: Underground tour of Edinburgh provided by City of the Dead Tours
**Wednesday 29th June 2016 at 7.30pm: Summer school meal at the Salisbury Arms