Introduction :

1-2 frontal lectures

Module 1 – Estimation :

6 frontal lectures

2 supervised exercises

Tentative Topics

- MVU estimator, CRLB

- Linear Models, BLUE

- ML estimator

- Bayesian estimators

- MSE and MAP estimators

- Linear Models, LMMSE estimator

Module 2 – Detection :

5 frontal lectures

2 supervised exercises

Tentative Topics :

* Detection intro (hypothesis testing basics, confusion matrix, influence no. of samples, estimation versus detection)
* Neyman-Pearson (NP) detector (standard ratio test, probability of false alarm/detection, ROC, examples)
* Bayes Risk (maximum a posteriori and maximum likelihood detectors, examples)
* Matched filters or replica-correlators  (NP and Bayes versions, examples)
* Energy detection (estimator-correlator, examples)

Remarks:

Topics 2 and 4 assume deterministic signal components

Topic 5 assumes random signal component with known statistics

All lectures deal with discrete-time signals, and samples under each hypothesis are perfectly aligned with the observation window.

Module 3 – Classification :

5 frontal lectures

2 supervised exercises

Tentative Topics

- why is classification important

- definition and comparison to detection

- some applications

- a complete classification system and the role of the modules

- the theoretical optimal MAP classifier

- static classification vs dynamic recognition

- linear vs nonlinear classifiers, parametric vs non-parametric classifiers

- the role of estimation in classifiers

- using estimation for design/training and performance evaluation

- three basic classifiers : linear, plug in MAP, template based.

- a classification example including performance for the above three classifiers

- short on other classifiers including deep neural networks

Summary :

1 frontal lecture

Projects :

1 lecture (presentation)

5/7 supervised sessions (double hours)