MIOT H6020: Advanced Signal Processing

Short Title:	Advanced Signal Processing APPROVED
Full Title:	Advanced Signal Processing

Module Code:	MIOT H6020

ECTS credits:	5

NFQ Level:	9

Module Delivered in	1 programme(s)

Module Contributor:	Barry Kirkpatrick

Module Description:	The aim of this module is to introduce the learner to DSP algorithms and how they can be employed to solve problems in the context of Internet of Things applications. This will include spectral estimation, digital filtering, modelling and Kalman filtering.

Learning Outcomes:

On successful completion of this module the learner will be able to

1. Outline and explain the applications of DSP, the role of each component in a DSP system and how DSP is utilised in Internet of Things technologies.
2. Analyse and interpret signal characteristics in the time and frequency domains.
3. Implement digital signal processing algorithms in a programming environment.
4. Design and analyse digital filters.
5. Implement and evaluate Kalman filtering as a tool to deal with imperfect sensor measurements in the context of Internet of Things technologies.

Module Content & Assessment

Indicative Content
Digital Signal Processing Systems and The Internet of Things Overview of the primary application areas of DSP within the context Internet of Things etchnologies. The advantages and flexibility of DSP over analogue signal processing. Applications in which it is currently not feasible to use DSP. Components of a DSP system. Sampling theory, anti-aliasing filters and signal reconstruction.
Time-Domain Signal Processing Correlation, convolution, signal synthesis, resampling, requantization.
Filter Theory Design Techniques, system transfer function, system stability, Z-transform, magnitude and phase response curves, quantisation effects. Digital filters as models of physical systems.
Frequency-Domain Transforms and Processing Discrete Fourier Transform, Spectral Leakage, Spectral Smearing, Fast Fourier Transform, Short-Time Fourier Transform, Spectrum estimation using the Discrete Fourier Transform.
Kalman Filter Dealing with noisy uncertain data measurements and the applicability of the Kalman filter. Structure of the Kalman filter, the Kalman gain. The Kalman filter algorithm and its application to case study examples. Overview of vectorised Kalman filtering and data fusion.

Indicative Assessment Breakdown	%
Course Work Assessment %	100.00%

Course Work Assessment %

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Short Answer Questions	Learners will complete a series of quizzes and short tutorial sheets and will be interviewed on their understanding of the solutions to assignments as they progress though the module.	1,2,3,4	20.00	n/a
Project	Learners will complete a project in which they apply their DSP knowledge to solve a relatively complex problem, which is not very well defined. The aim of the project is to assess the student's ability to evaluate the variety of DSP techniques available and apply appropriate processes to solve the problem. Learners are required to write a report on their project and present their solution.	2,3,4	40.00	n/a
Project	In this project learners will apply Kalman filtering to solve a problem with noisy sensor data in an Internet of Things application. The final output will be a report and presentation.	3,4,5	40.00	n/a

No Final Exam Assessment %

Indicative Reassessment Requirement

Repeat the module
The assessment of this module is inextricably linked to the delivery. The student must reattend the module in its entirety in order to be reassessed.

ITB reserves the right to alter the nature and timings of assessment

Indicative Module Workload & Resources

Resources
Recommended Book Resources
Richard G. Lyons 2011, *Understanding Digital Signal Processing*, 3rd Edition Ed., Prentice Hall. **Monson H. Hayes, *Statistical digital signal processing and modeling*, Chapter 7 - Optimum Filtering, New York ; John Wiley & Sons, c1996. [ISBN: 0471594318]**
Supplementary Book Resources
Smith S.W. 1997, *The Scientists and Engineers Guide to Digital Signal Processing*, California Technical Publishing **John G. Proakis, Dimitris G. Manolakis 2006, *Digital signal processing*, Pearson Prentice Hall Upper Saddle River, N.J. [ISBN: 0131873741]**
This module does not have any article/paper resources
This module does not have any other resources

Module Delivered in

Programme Code	Programme	Semester	Delivery
BN_EMIOT_R	Master of Engineering in Internet of Things Technologies [BN535R 60 credits taught with a 30 credit research project]	2	Elective