ES97H-15 Biomedical Signal Processing

24/25

Department
School of Engineering
Level
Taught Postgraduate Level
Module leader
Nigel Stocks
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES97H Biomedical Signal Processing

Module web page

Module aims

To introduce students to the principles of signal processing techniques when applied specifically to biomedical signals, including: ECG, MEG, EEG, SPO2, heart rate etc.

The module will provide the student with a firm grounding in methods and tools for extracting information from digitally acquired biomedical signals.

The module will introduce the practical implementation of signal processing techniques to digitally acquired biomedical signals.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be

covered. Actual sessions held may differ.

- Introduction to Biomedical Signals
  o The Nature of Biomedical Signals
  o Examples of Biomedical Signals
  o Objectives and Difficulties of Biomedical Signal Analysis
- Revision of pre-requisites
  o Linear Systems Theory (continuous and discrete time)
  o Spectral methods (FT, DTFT, DFT, PSD)
- Signal Acquisition
  o Measurement systems
  o Sampling theorem
  o Analogue-digital-conversion
  o windowing
- Filtering
  o Filter types
  o Analogue
  o Digital FIR IIR
- Random Physiological Signals
  o Signal as a Stochastic Process
  o Averaging techniques
- Advanced Methods of Biomedical Signal Processing
  o DSP hardware and implementation
  o Medical Devices

Learning outcomes

By the end of the module, students should be able to:

- Demonstrate a systematic knowledge of the complex physical and physiological principles that underpin biomedical signals.
- Demonstrate an advanced understanding of the principles of digital signal processing
- Systematically apply methods to extract relevant information from biomedical signal measurements [M1, M2, M3]
- Critically assess the appropriateness of biomedical signal processing techniques for various problems in the field [M1]
- Evaluate the effectiveness of techniques applied to biomedical signals against specific benchmarks [M3]
- Work as a team to solve a complex problem using Biomedical Signal Processing Techniques [M1, M2, M3, M16]

Indicative reading list

1. Ramgaraj M. Rangayyan, Biomedical Signal Analysis: A Case-Study Approach. IEEE press 2001
2. Eugene N. Bruce, Biomedical Signal Processing and Signal Modeling, John Wiley & Sons, 2000

3. A V Oppenheim & R W Schafer, Discrete-time Digital Signal Processing, 2009, ISBN-13: 978-0131988422 ISBN-10: 0131988425 Edition: 3rd, Prentice-Hall: Englewood Cliffs, NJ

Research element

Research for Group project

Interdisciplinary

signal processing and biological signals including pathology

Subject specific skills

Matlab programming. Filter design. Noise reduction. data acquisition.

Transferable skills

Team work. presentation and communication skills.

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (13%)
Practical classes	3 sessions of 3 hours (6%)
Other activity	4 hours (3%)
Private study	117 hours (78%)
Total	150 hours

Private study description

Guided independent learning 117 hours

Other activity description

Revision Classes 2x2 hours

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A2

	Weighting	Study time
Group presentation	40%	
Group presentation of main results of the group project		
In-class test	60%	
A combination of qualitative and quantitative short answers		

Feedback on assessment

Model solutions to past papers.
Support through office hours.
Written feedback on assignment.
Cohort-level feedback on in-class test
Face to face feedback in laboratories

Availability

Pre-requisites

To take this module, you must have passed:

- All of
  - ES3C5-15 Signal Processing

Courses

This module is Optional for:

- Year 1 of TESA-H800 Postgraduate Taught Biomedical Engineering

This module is Core option list A for:

- Year 4 of UESA-H163 MEng Biomedical Systems Engineering
- Year 5 of UESA-H164 MEng Biomedical Systems Engineering with Intercalated Year

This module is Core option list B for:

- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering
- UCSA-G409 Undergraduate Computer Systems Engineering (with Intercalated Year)
    - Year 4 of G409 Computer Systems Engineering (with Intercalated Year)
    - Year 5 of G409 Computer Systems Engineering (with Intercalated Year)