ES4E7-15 Information Theory and Coding

26/27

Department
School of Engineering
Level
Undergraduate Level 4
Module leader
Daciana Iliescu
Credit value
15
Module duration
10 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The subject of Information Theory underpins all of modern communications and hence the connected world in which we live. This module provides insight into this important topic plus the compression and error-control coding schemes used in communication systems. It provides the means to quantify information; introduces entropy; presents a quantitative approach to the capacity of communication channels; investigates the methods and limits of source coding and reliable communications.

Module web page

Module aims

To provide the understanding and analytical tools necessary to apply information theory to a range of relevant modern problems in communication engineering. In particular: to convey the source coding and noisy channel theorems; to furnish students with the means to compute information theoretic quantities; to deliver the principles and applications of source codes; to convey the principles and applications of channel codes; to provide exposure to the latest developments in the area.

Students will gain: Substantial knowledge of information and entropy, and their use in information theory. Principles and practice of data compression. Channel capacity of common communication channels. Design and performance evaluation of error correcting codes. Knowledge of lossy compression. Exposure to emerging topics in information theory, coding and compression.

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 information theory; information and entropy; data compression; source coding theorem; symbol codes, stream codes; noisy channels; noisy channel coding theorem; channel capacity; example channels – e.g. Gaussian, binary symmetric and binary erasure; error correcting codes – block codes (e.g. Hamming and Reed Solomon) – convolutional codes; lossy compression –principles and practice (e.g. JPEG, MPEG, H.264); further reading on a selection of emerging topics such as Stochastic Resonance, fountain codes, molecular communications, physical layer security.

Learning outcomes

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

- Demonstrate advanced knowledge and understanding of information and entropy, and their application in information theory. [M1, M2]
- Apply the principles of data compression to design and evaluate specific data compression techniques. [M1, M2]
- Design and evaluate the error performance of specific error correcting codes. [M1, M2, M4]
- Apply the principles of noisy channel analysis to calculate the capacity of common communication channels. [M1, M2]
- Utilise underlying information theoretic principles to design and analyse implementations of lossy compression. [M2]

Indicative reading list

Reading lists can be found in Talis

Subject specific skills

Comprehensive understanding of the principles of data transmission, compression and error correction.
Critical awareness of current developments in information theory and coding.
Ability to apply appropriate engineering analysis methods for solving problems of information theory and coding, and to assess the limitations of the methods employed.
Thorough understanding of modern data transmission practice, its limitations, and appreciation of likely new developments.

Transferable skills

Ability to express advanced technical concepts concisely and accurately and comment on their applications, limitations and implications.
Ability to select, adapt and apply a range of mathematical techniques to solve advanced problems and explain the implications of the answer.

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (13%)
Tutorials	5 sessions of 1 hour (3%)
Other activity	2 hours (1%)
Private study	123 hours (82%)
Total	150 hours

Private study description

Self-study, problem sheets, background reading and revision - total of 123 hours.

Other activity description

2x1 hour Revision Session

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B3

	Weighting	Study time	Eligible for self-certification
Assessment component			
Centrally-timetabled examination (On-campus) Unseen Examination	100%		No

- Answerbook Gold (24 page)
- Students may use a calculator
- Engineering Data Book 8th Edition
- Graph paper

Reassessment component is the same

Feedback on assessment

Model solutions are published for past examination papers.
Cohort level feedback on examinations is provided.

Past exam papers for ES4E7

Availability

Courses

This module is Core for:

- Year 1 of TESA-H641 Postgraduate Taught Communications and Information Engineering

This module is Optional for:

- Year 4 of UESA-H116 MEng Engineering with Exchange Year
- Year 5 of UESA-H115 MEng Engineering with Intercalated Year
- Year 1 of TCSA-G5PA Postgraduate Taught Data Analytics
- Year 5 of UESA-H607 Undergraduate Electrical and Electronic Engineering with Intercalated Year
- Year 4 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics

This module is Option list A for:

- Year 4 of UESA-H63X MEng Electronic Engineering
- Year 5 of UESA-H636 MEng Electronic Engineering with Intercalated Year
- Year 5 of UESA-H63Y MEng Electronic Engineering with Intercalated Year
- Year 4 of UESA-H114 MEng Engineering
- Year 1 of TESA-H644 Postgraduate Taught Electrical and Electronic Engineering
- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 4 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng

This module is Option list G for:

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