Course guide
320119 - COM - Multimedia Encoding

Last modified: 19/04/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: IGNASI ESQUERRA LLUCIÀ

Others: Javier Ruiz Hidalgo
Josep Ramon Morros
Albert Mosella

PRIOR SKILLS

Students will be expected to have passed all of the subjects related to mathematics and IT/programming, as well as Signals and Systems, Digital Image Processing and Digital Audio Processing.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE25-ESAUD. Ability to create, encode, manage, disseminate, and distribute multimedia content, taking into account criteria of usability and accessibility of audiovisual, broadcasting, and interactive services. (Specific Technology Module: Sound and Image)

TEACHING METHODOLOGY

- Face-to-face lecture sessions.
- Face-to-face practical work sessions.
- Independent learning and exercises.
- Preparation and completion of group activities subject to assessment.

In the face-to-face lecture sessions, the lecturer will introduce the basic theory, concepts, methods and results for the subject and use examples to facilitate students' understanding.
Students will be expected to study in their own time to become familiar with the concepts, using their own notes taken in theory classes and the compulsory and recommended reading lists. It is particularly important that students read in their own time the assigned articles from the scientific literature.
Students are expected to complement in-class programming activities with independent learning activities outside of class in order to gain sufficient algorithm-coding practice in the appropriate programming language (MATLAB or C++).

LEARNING OBJECTIVES OF THE SUBJECT

This subject will cover basic source-coding techniques. Students will become familiar with the main audio and video coding algorithms and the parameters that affect them, and will learn to use them in applications related to the transport, management and distribution of multimedia content. They will also take an in-depth look at the main audiovisual coding standards. They will build on the specific and transversal competencies associated with coursework, as described below.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	30.00
Hours small group	15,0	10.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

TOPIC 1: SOURCE CODING

Description:
- Introduction
a. Chain coding.
- Fundamentals of source coding.
a. Entropy.
b. Fixed-length and variable-length codes.
c. Prefix codes: Huffman.
d. Universal coding: Lempel Ziv.

Related activities:
Laboratory: Calculation of entropy, Huffman coding, Lempel Ziv coding.

Full-or-part-time: 38h 45m
Theory classes: 11h 15m
Laboratory classes: 5h
Self study : 22h 30m

TOPIC 2: IMAGE CODING

Description:
- Quantisation.
- Transform coding.
- Rate-distortion.
- Scalability.
- Standards: JPEG, JPEG 2000 and JBIG.

Related activities:
Laboratory:
- Image coding, rate-distortion curves (R-2D). Applied exercises.

Full-or-part-time: 36h 15m
Theory classes: 11h 15m
Laboratory classes: 2h 30m
Self study : 22h 30m

TOPIC 3: VIDEO CODING

Description:
- Hybrid model.
- Motion estimation.
- MPEG standards.
- 3D coding.

Related activities:
Laboratory:
- Video coding, rate-distortion curves.
- Scalability.

Full-or-part-time: 36h 15m
Theory classes: 11h 15m
Laboratory classes: 2h 30m
Self study : 22h 30m

TOPIC 4: AUDIO CODING

Description:
- Filter banks. Transforms. Multichannel techniques
- Speech coders (ADPCM and CELP)
- Audio coders (MPEG)
- Lossless encoders (FLAC)
- Quality evaluation

Related activities:
Laboratory:
Speech coding. Audio coding.

Full-or-part-time: 38h 45m
Theory classes: 11h 15m
Laboratory classes: 5h
Self study : 22h 30m

GRADING SYSTEM

- Exam1: 20%
- Exam2: 20%
- Exam3: 20%
- Exam4: 20%
- Laboratory: 20%

If the average grade of the four exams is lower than 5, a written final exam will be done, covering all the topics studied during the course. The result of this exam will replace the average grade of the four exams carried out during the course.

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.
If the average grade of the four exams is less than 5, a written test (final exam day) will be included, which will include all the subjects studied during the course. The result of this test will replace the average grade of the four exams completed during the course only if it exceeds these. "

BIBLIOGRAPHY

Basic:
- González, Rafael C. Digital image processing. 3rd ed. Harlow: Pearson Prentice Hall, 2008. ISBN 9780131687288.
- Carlson, A. Bruce. Communication systems: an introduction to signals and noise in electrical communication. 4th ed. New York: McGraw-Hill, 2002. ISBN 0070111278.
- Clarke, R. J. Digital compression of still images and video. London: Academic Press, 1995. ISBN 012175720X.

Complementary:
- Bäckström, Tom. Speech coding: with code-excited linear prediction [on line]. Cham: Springer International Publishing, 2017 [Consultation: 03/10/2022]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-319-50204-5. ISBN 9783319502045.
- You, Yuli. Audio Coding: Theory and Applications [on line]. Boston, MA: Springer, 2010 [Consultation: 13/06/2019]. Available on: http://dx.doi.org/10.1007/978-1-4419-1754-6. ISBN 9781441917546.
- Bosi, M; Goldberg, R.E. Introduction to digital audio coding and standards. Boston: Kluwer Academic Publishers, 2003. ISBN 1402073577.
- Wang, Y; Ostermann, J.; Zhang, Y. Video processing and communications. Upper Saddle River: Prentice Hall, 2002. ISBN 9780130175472.
- Ghanbari, Mohammed. Standard codecs: image compression to advanced video coding [on line]. 3rd ed. London: Institution of Electrical Engineers, 2011 [Consultation: 03/10/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=774059. ISBN 9780863419645.