Research Master’s program: Information Processing and Complexity of the Living

Mastère de recherche : Traitement de l’Information et Complexité du Vivant (TICV)

TC : Tronc commun, SPI : Option Signal Perception Image, Option BioS : Biosystémique

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|  | **SPI – Perceptual Approaches in Sound Processing** |
| **Semester:** Fall, **Academic Year:** 2020/21 |

**Instructor information**

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| **Name** | Sonia DJAZIRI-LARBI, Associate Professor |
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| **Office location / Affiliation** | Ecole Nationale d’Ingénieurs de Tunis |

**Course Description**

This course is part of the Teaching Unit “Audio and Perception”. It focusses on the understanding of the human auditory mechanisms and how they are related to digital audio processing techniques.

Perceptual audio processing methods are explained and discussed in terms of perceptual efficiency and perceptual (subjective) quality evaluation.

**Objectives and Learning Outcomes**

Upon successful completion of the course, students will have an understanding of the close relationship between perceptual audio processing techniques and human auditory characteristics and associated topics. Specific learning objectives are:

* Understand the basics of auditory perception, psychoacoustics, and psychoacoustic models
* Apply psychoacoustics in coding, features extraction, data hiding, etc.

**Prerequisites**

Advanced Digital Signal Processing

**Learning Resources**

Personal computers, Matlab or Scilab

**Assessments**

The final course grade will be calculated using the following categories:

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| **Assessment** | **Percentage of Final Grade** |
| Final exam | 80% |
| Programming assignment | 20% |

Students will be assigned the following points, based on calculations coming from the course assessment section: **Grade** = gained points from a total of 20 points

**Course Schedule**

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| **Lecture #** | **Theme/Topic** | **Learning Outcomes Addressed** |
| #1 (3H) | Audio perception | The human ear‘s mechanisms (basilar membrane, cochlea, ear cells,…)  Quantifying perception: Sones and Phones, Loudness, Sound Pressure Level  Auditory Masking: Frequency Masking, Absolute Hearing Threshold, Critical Bands, Bark scale, Psychoacoustic Models |
| #2 (3H) | Audio coding | MPEG-1 Layer III coder |
| Programming Assignment (3H) | MPEG – 1 layer 3 | Understand and test the psychoacoustic model, the filter bank, using provided Matlab/Scilab codes |
| #3 (3H) | Practical session  MPEG – 1 layerIII | MPEG – 1 layer III  manipulation of the complete coder with Matlab (Scilab).  Quality vs. bitrate evaluation, testing with different music genre, … |
| #4 (3H) | Perceptual audio data hiding | Spread spectrum techniques  Quantization Index Modulation techniques |
| #5 (3H) | Audio features extraction  OR[[1]](#footnote-1)  Subjective vs. Objective Quality Assessment | Music: Features related to rhythm, tempo, melody  Speech: MFCC, spectrogram, …  Quality definitions, Objective assessment (PEAQ, PESQ, SegSNR, SegLLR, etc.)  Subjective assessments Standards (ITU-T) and Methods |
| Reading Assignment (3H) | Scientific article |  |

1. The decision is made depending on the students interests [↑](#footnote-ref-1)