

Course Unit	Signal Processing Applications	Field of study	Telecommunications and Signal Processing		
Master in	Industrial Engineering - Electrical Engineering	School	School of Technology and Management		
Academic Year	2020/2021	Year of study	1	Level	2-1
Type	Semestral	Semester	2	ECTS credits	6.0
Code	9572-355-1201-00-20				
Workload (hours)	162	Contact hours	T -	TP 30	PL 30
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) João Paulo Ramos Teixeira

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. have control of the signal processing techniques;
2. know and use the fundamentals and techniques of speech processing, namely: models of speech production, analysis, synthesis and recognition of speech and speaker and codification;
3. design, train and use Support Vector Machines;
4. design, train and use feed-forward artificial neural networks for prediction and classification purposes.

Prerequisites

Before the course unit the learner is expected to be able to:

1. programme under Matlab environment;
2. process signals under Matlab environment;
3. understand the dual representation of signals in time-domain and frequency-domain.

Course contents

Human vocal tract. Model of speech production. Analysis of speech waveforms. Speech synthesis: speech synthesis methods; notions of phonetics and prosody; architecture of TTS systems. Automatic speech recognition. Recognition of isolated words and continuous speech, speaker recognition: ANN. Introduction to feed-forward ANN: functioning, architecture, training algorithms. Codification of waveform. Support Vector Machines. Wavelet Transform.

Course contents (extended version)

1. Speech Production Process
 - Anatomy and physiology of the vocal tract;
 - Model of production of speech.
2. Speech Waveform Analysis
 - Introduction to the speech signal processing techniques and models;
 - Analysis of signals: time domain, spectral, cepstral and parametric analysis by linear prediction.
3. Speech Synthesis
 - Text-to-Speech (TTS) systems;
 - Linguistic, prosodic and acoustic processing blocks;
 - Introduction to phonetic and prosody;
 - TTS systems architecture;
 - Choosing the best speech interface system;
 - Introduction to Automatic Speech Recognition;
 - Speaker Recognition.
4. Introduction to Feed-Forward Artificial Neural Networks
 - Functioning;
 - Architecture;
 - Training algorithms.
5. Support Vector Machines
6. Wavelet Transform

Recommended reading

1. Modelização Paramétrica de Sinais Para Aplicação em Sistemas de Conversão Texto-Fala, João Paulo Teixeira, Dissertação de Mestrado, FEUP, 1995.
2. Digital Processing of Speech Signals, Rabiner and Schafer, Prentice-Hall, 1978.
3. Fundamentals of Speech Synthesis and Speech Recognition - Basic Concepts, State of the Art and Future Challenges, Eric Keller - JONH WILEY & SONS 1994
4. Prosody Generation Model for TTS Systems - Segmental Durations and F0 Contours with Fujisaki Model, João Paulo Teixeira, Lambert Academic Publishing, 2012.
5. Speech Processing and Synthesis Toolboxes, Childers, D. G., J. Wiley and Sons, 2000.

Teaching and learning methods

The issues are briefly presented in the classes and one work by each chapter is required. The work is accompanied by the teacher in the classes. The 4 non presence hours are used for studying the issues and development of the works started in the classes. The works are developed using software like Praat and Matlab.

Assessment methods

- Single - (Regular, Student Worker) (Final, Supplementary, Special)
- Practical Work - 100% (The developed works are subject to a report and a formal presentation.)

Language of instruction

1. Portuguese
2. Portuguese, with additional English support for foreign students.

Electronic validation

João Paulo Ramos Teixeira	José Luís Sousa de Magalhaes Lima	José Alexandre de Carvalho Gonçalves	Paulo Alexandre Vara Alves
22-02-2021	08-03-2021	08-03-2021	21-03-2021