Course Unit	Rehabilitation Technology		Field of study	Orthopedics and Rehabilitation	
Master in	Biomedical Technology - Biomechanics and Rehabilitation		School	School of Technology and Management	
Academic Year	2018/2019	Year of study	1	Level	2-1
				ECTS credits	6.0
Type	Semestral	Semester	2	Code	5025-421-1205-00-18

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 - Tuturial; O - Other

Name(s) of lecturer(s)	João Paulo Ramos Teixeira, João da Rocha e Silva

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. acknowledge the vocal tract and auditory human apparatus;
2. be awareness of the aid that can be given by synthesis and recognition speech systems to the hearing, visual and vocal tract rehabilitation;
3. knowing the methods of producing synthetic speech (synthesis engines) and speech recognition as well as the difficulties and limitations of each model;
4. know interface systems for rehabilitation assistance;
5. know and extract some important characteristics of the speech signal in identifying pathologies associated with vocal tract apparatus;
6. understand and analyze the pathological human gait, compared to normal gait;
7. use technical kinematical, thermographic and electromyography analysis in the context of rehabilitation.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Programming in Matlab, C or other environment;
2. know the Functional anatomy or similar.

Course contents

Support technologies for persons with disabilities and the elderly - technological, human and socio-economic components. Accessibility. Aids for Communication, Mobility, Handling and Guidance. Instrumentation and biomechanical assessment. Posture and locomotion. Neurmuscular function.

Course contents (extended version)

1. Speech production
   - Human speech apparatus
   - Hearing apparatus
   - Speech production model
   - Determination of Pitch – F0
   - Jitter and Shimmer
   - Formants
   - European Portuguese phonetic alphabet
2. Text-to-Speech (TTS) systems
   - Blocks of a TTS system
   - Synthesis models
   - Commercial TTS systems
   - TTS systems support to visual or phonatory impaired persons
3. Automatic Speech Recognition (ASR) systems
   - Speaker identification
   - Isolated word recognition
   - Continuous speech recognition
   - ASR systems support to hearing of visual impaired persons
4. Artificial Neural Networks (ANN)
   - Architecture of ANN
   - Learning process
   - Feed-forward ANN
   - Application of ANN
   - ANN under Matlab
5. Instrumentation and biomechanical assessment
   - Kinematical procedures
   - Kinetic procedures
   - EMG procedures
   - Thermographic procedures
6. Posture and locomotion
   - concepts
   - Efficiency and energy cost
   - Mechanical work, mechanical power and mechanical energy
7. Neuromuscular function
   - Neural contributions for the strength
   - Morphological contributions for the strength
   - Hormonal contributions for the strength
   - Strength mechanical models
   - Streching shorting cycle

Recommended reading

1. An introduction to rehabilitation engineering, Cooper, Rory A. New York : Taylor & Francis, cop. 2007;
2. Fundamentals of Speech Synthesis and Speech Recognition - Basic Concepts, State of the Art and Future Challenges, Eric Keller - Jonh Wiley & Sons 1994;
3. Speech Processing and Synthesis Toolboxes, Childers, D. G. , J. Wiley and Sons, 2000;
4. Biomechanics and Motor control of Human Movement, David A. Winter, John Wiley, 1990;
5. Biomechanics and Biology of movement. Human Kinetics, IL, Nigg B, MacIntosh B, Mester J. , 2000.

Teaching and learning methods

During the lectures, the teacher presents the subject and the students begin their work / short-projects. During the 4 non presence hours students do self-study and complete the work.

Assessment methods

- Single - (Regular, Student Worker) (Final, Supplementary, Special)
    - Experimental Work - 60%
    - Final Written Exam - 40%

Language of instruction

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

Electronic validation

João da Rocha e Silva, João Paulo Ramos Teixeira	Ângela Paula Barbosa da Silva Ferreira	Fernando Jorge Coutinho Monteiro	Nuno Adriano Baptista Ribeiro
11-03-2019	01-04-2019	02-04-2019	27-06-2019