Modulbezeichnung:	**Interfacing the Neuromuscular system: Applications for Human/Machine Interfaces and Neurophysiology (INS)** (Interfacing the Neuromuscular system: Applications for Human/Machine Interfaces and Neurophysiology)	**5 ECTS**
Modulverantwortliche/r:	Alessandro Del Vecchio, Daniela Souza de Oliveira, Assistenten	
Lehrende:	Alessandro Del Vecchio	

Startsemester: SS 2022	Dauer: 1 Semester	Turnus: jährlich (SS)
Präsenzzeit: 60 Std.	Eigenstudium: 90 Std.	Sprache: Englisch

Lehrveranstaltungen:

Interfacing the Neuromuscular system: Applications for Human/Machine Interfaces and Neurophysiology (SS 2022, Vorlesung, 3 SWS, N.N.)

Inhalt:

Module: Principles of Neural control of movement and neuroengineering
How the central nervous system controls muscle forces; Neurons, upper and lower motoneurons, Cortical and brainstem function, Interneurons and Motor Units. Neuroengineering applications for studying the neural control of movement; invasive and non-invasive recordings, electrical stimulation of the nervous system.
Module: Electrophysiology Generation of an action potential; Hodgkin - Huxley model, difference between intracellular and extracellular action potential, sparsity of the action potential in a matrix of electrodes. Recording electrophysiological data in humans; examples of EMG and EEG recordings.
Module: Applications to Human/Machine Interfaces Biosignal processing; data with high temporal resolution, identification of individual neurons, associations between neuronal discharge times and behaviour; control of prosthetic devices from EMG signals in amputees and neurodegenerative and neurotraumatic diseases.
Module: Applications to Neurophysiology Neuronal encoding of behaviour; motor unit physiology in humans; motoneuron properties, longitudinal assessment of neuronal function. Module: MATLAB / Python practical coursework Extraction of neural information from electrophysiological signals; associations of information between electrophysiological signals and behavioural data; Experiment in humans.

Lernziele und Kompetenzen:

The students will acquire in-depth skills in the acquisition, analysis, and interpretation of electrophysiological data with a specific focus on human recordings in health and pathological conditions (e.g., spinal cord injury, stroke, and Parkinson's disease). The goal of this course is to teach the current methods in man/machine interfaces and neurophysiological applications. The course will provide information on the neural circuitries that determine coordinated movement. The specific focus is on the motor system that regulates skilled motor behaviour. We will study the physiological pathways of the motor system and the effect of neurodegenerative diseases that affect this system. Ultimately, this course will give students a robust overview of how to use electrophysiology in order to assist individuals with neural impairments.

Literatur:

- Principles of Neuroscience from Eric R. Kandel, MD
- Motor unit from Heckman and Enoka, DOI: 10.1002/cphy.c100087
- Surface Electromyography, Physiology, Engineering, and Applications Edited by Roberto Merletti and Dario Farina
- Neural Engineering, Edited by Bin He
- Tutorial: Analysis of motor unit discharge characteristics from high-density surface EMG signals, Del Vecchio et al. https://doi.org/10.1016/j.jelekin.2020.102426
- Restoring sensorimotor function through intracortical interfaces: progress and looming challenges, Bensmaia and Millerhttps://www.nature.com/articles/nrn3724

Verwendbarkeit des Moduls / Einpassung in den Musterstudienplan:

Das Modul ist im Kontext der folgenden Studienfächer/Vertiefungsrichtungen verwendbar:

[1] **Data Science (Bachelor of Science)**

(Po-Vers. 2022s | Gesamtkonto | Anwendungsfächer | Artificial intelligence in biomedical engineering (AIBE) | Interfacing the Neuromuscular system: Applications for Human/Machine Interfaces and Neurophysiology)

Dieses Modul ist daneben auch in den Studienfächern "Artificial Intelligence (Master of Science)", "Data Science (Master of Science)", "Informatik (Bachelor of Science)", "Informatik (Master of Science)", "Medizintechnik (Bachelor of Science)", "Medizintechnik (Master of Science)" verwendbar.

Studien-/Prüfungsleistungen:

Interfacing the Neuromuscular system: Applications for Human/Machine Interfaces and Neurophysiology (Prüfungsnummer: 41561)

Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 30

Anteil an der Berechnung der Modulnote: 100% Prüfungssprache: Englisch

Erstablegung: SS 2022, 1. Wdh.: WS 2022/2023

1. Prüfer: Alessandro Del Vecchio
