Modulbezeichnung: **Selected Topics in ASC (STASC)** **5 ECTS**
(Biomedical Signal Analysis)

Modulverantwortliche/r: Björn Eskofier
Lehrende: Raj Rangayyan

Startsemester: SS 2021	Dauer: 1 Semester	Turnus: jährlich (WS)
Präsenzzeit: 60 Std.	Eigenstudium: 90 Std.	Sprache: Englisch

Lehrveranstaltungen:

Selected Topics in ASC - Biomedical Signal Analysis (SS 2021, Vorlesung, 4 SWS, Raj Rangayyan)

Empfohlene Voraussetzungen:

Broad Areas of the Course: Biomedical Engineering, Digital Signal Processing, Information and Communication Technology, Electrical and Computer Engineering, Electronics and Communication Engineering

Inhalt:

Content:

Introduction to the electrocardiogram (ECG), electroencephalogram (EEG), electromyogram (EMG), heart sounds, and other biomedical signals.

Computer techniques for processing and analysis of biomedical signals. Digital filters and digital signal processing techniques to remove noise and artifacts: moving average, Wiener, adaptive, and frequency-domain filters. Techniques for detection of events and epochs in biomedical signals: detection of the QRS complex in the ECG; correlation techniques and matched filters to detect patterns in the EEG. Methods for extraction of quantitative features or attributes from biomedical signals: analysis of shape, envelope, and statistical parameters of signals. Analysis of biomedical signals in the time and frequency domains: applications of correlation functions and the Fourier power spectrum.

Introduction to pattern classification and decision techniques for computer-aided diagnosis. Case studies from current applications and research.

Lernziele und Kompetenzen:

This course facilitates development of the following competences and skills in students:

- Learn about the genesis of biomedical signals such as the action potential, EMG, ECG, EEG, and heart sound signals.
- Review basic concepts of signals, systems, and digital filters.
- Study the characteristics of biomedical signals: stationarity, periodicity, rhythm, wavelet, epoch, episode, and transient.
- Learn signal processing techniques for filtering, noise removal, cancellation of interference, and characterization of signals.
- Design and implement techniques for the detection of events such as the QRS complex, heart sounds and murmurs, and the dicrotic notch.
- Explore techniques for the analysis of wave shape and waveform complexity.
- Learn about Fourier spectral analysis of biomedical signals.
- Investigate pattern classification and decision techniques for computer-aided diagnosis.
- Design, develop, and implement methods for analysis of biomedical signals.

Literatur:

Textbook: R.M. Rangayyan, "Biomedical Signal Analysis," Second Edition, IEEE Press and Wiley, New York, NY. 2015. 672 pages. ISBN 9780470911396.

Verwendbarkeit des Moduls / Einpassung in den Musterstudienplan:

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

[1] **Advanced Signal Processing & Communications Engineering (Master of Science)**
(Po-Vers. 2020w | TechFak | Advanced Signal Processing & Communications Engineering (Master of Science) | Gesamtkonto | Selected Topics in ASC)

Studien-/Prüfungsleistungen:

Selected Topics in Signal Processing and Communications (Prüfungsnummer: 572396)
(englische Bezeichnung: Selected Topics in Signal Processing and Communications)

Untertitel: Biomedical Signal Analysis Prüfungsleistung, Klausur, Dauer (in Minuten): 90
Anteil an der Berechnung der Modulnote: 50%
weitere Erläuterungen:
gemäß Corona-Satzung wird als alternative Prüfungsform festgelegt: Mündliche Prüfung mit 30 Minuten Dauer
Prüfungssprache: Englisch

Erstablegung: SS 2021, 1. Wdh.: keine Wdh.
1. Prüfer: Björn Eskofier

Organisatorisches:

Prerequisites, Background Review, and Preparation: Students are advised to review a textbook on Signals, Systems, and Transforms. Students are also advised to familiarize themselves with MATLAB and the associated Signal Processing Toolbox.
Laboratory Exercises: The laboratory component of the course involves development of computer programs to process biomedical signals and analysis of the results obtained; MATLAB is recommended, but students may implement their own code in other languages. Two students may work together as a group. The time periods shown in the course schedule are suggested times for the lab exercises; however, there are no physical lab sessions and students will work on their own. No report needs to be submitted and no marks are allocated for the lab exercises; however, it is important that the exercises are completed as described to gain practical experience and thorough understanding of the subject matter. Details regarding the lab exercises will be provided during the course.
Further Information: Laboratory exercises and projects, signal data files, previous examinations, updates to the textbook, solutions to selected problems, and additional material are provided through the website http://people.ucalgary.ca/ ranga/enel563/
Final Grade Determination: The final grade will be based on a written final examination to be scheduled after the end of the course. Calculators, electronic devices, books, or notes will NOT be permitted in the examination.

Bemerkungen:

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