Modulbezeichnung:	**Communications Systems Design (CSD)** (Communications Systems Design)	**5 ECTS**
Modulverantwortliche/r:	Georg Fischer	
Lehrende:	Georg Fischer	

Startsemester: WS 2021/2022	Dauer: 1 Semester	Turnus: jährlich (WS)
Präsenzzeit: 60 Std.	Eigenstudium: 90 Std.	Sprache: Englisch

Lehrveranstaltungen:

Communications Systems Design (WS 2021/2022, Vorlesung, 2 SWS, Georg Fischer)
Praktikum Communications Systems Design (WS 2021/2022, Praktikum, 2 SWS, Arslan Ali)

Empfohlene Voraussetzungen:

Bachelor Courses on Circuit and System design Bachelor Courses on Digital Modulation and MIMO Bachelor Courses on RF circuit Design

Inhalt:

- Introduction
- Analogue-Digital Balance
- Software Defined Radio
- ADC/DAC Converter Performance Metrics and their evolution over time
- Signal Distortion mechanisms and metrics (IP3, EVM, ACPR, Spectral mask, wideband noise, reverse intermod)
- Impairment modelling
- System Complexity Analysis for Mixed Signal Systems
- Transceiver architectures, design and analysis
- Chained Noise figures and IP3 figures
- Dynamic Range in RX and TX, Automatic Gain Control in RX and power control in TX
- Synchronous versus asynchronous Architectures (RF DAC, PLM)
- Challenges by Duplex operation, FDD, TDD, same frequency, TX-RX

isolation, transmitter leakage cancelation

- Simulation techniques (HB, Transient, Circuit Envelope)
- Power Amplifier Systems, Amplifier architectures, Vector quantised PA, Class-S, DSM, PWM
- Amplifier linearization, digital predistortion
- MIMO Architectures
- Implementation of Active Antenna Arrays, calibration
- Spectrum Engineering
- Physical Layer definition in light of implementation challenges

The exercise will be conducted based on PC and USRP Software Defined Radios. National Instruments Labview Comsuite Toolbox will be used for designing and studying Communication Systems.

Lernziele und Kompetenzen:

Students

- can compare key performance indicators of alternative transceiver architectures
- can construct the line up with TX and RX
- can formulate requirements for transceivers
- can gauge isolation between TX and RX
- can choose a power amplifier class based on requirements
- can rate physical layer properties
- can assess complexity in analogue and digital domain

- can plan a simulation strategy for analysing transceivers-can categorise transceiver architectures for single or multiple antennas
- Can develop a predistorion system for power amplifiers

Literatur:

Ralf Rudersdorfer, Radio Receiver Technology: Principles, Architectures and Applications, Wiley, 2014
Frank Ellinger, Radio Frequency Integrated Circuits and Technologies, Springer, 2008
Abbas Mohammadi und Fadhel M. Ghannouchi, RF Transceiver Design for MIMO Wireless Communications, Springer, 2012

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. 2021w | TechFak | Communications Engineering (Master of Science) | Gesamtkonto | Technical Mandatory Electives | Communications Systems Design)

Studien-/Prüfungsleistungen:

Commmunications Systems Design (Prüfungsnummer: 700506)
(englische Bezeichnung: Commmunications Systems Design)

Prüfungsleistung, mündliche Prüfung, Dauer (in Minuten): 30
Anteil an der Berechnung der Modulnote: 100% Prüfungssprache: Englisch

Erstablegung: WS 2021/2022, 1. Wdh.: SS 2022
1. Prüfer: Georg Fischer (100226)
