3 Module

3.1 Studienrichtung Informationstechnik

3.1.1 Signal Theory

Module title: Signal Theory

Module summary
Module code: EITM 110I
Module coordinator: Prof. Dr. Franz Quint
Credits (ECTS): 6 CP workload: in lecture 60 h, independent study time 90 h
Semester: 1st or 2nd semester
Pre-requisites with regard to content: System Theory, Linear Algebra
Pre-requisites according to the examination regulations: none
Competencies: Upon successful completion, • the students are able to discern between measurement and estimation • the students are able to assess the quality of an estimator • the students know the design principles of estimators • the students can design linear estimators with the least-squares cost function • understand the fundamental importance of the Gauß-Markov-theorem • apply the estimation principles to the estimation of spectra • have understood the problems that arise with time windowing • can implement DFT-based spectral estimation methods • can design model-based and subspace based spectral estimators
Assessment: Assessment is done by either a written exam (120 minutes) or an oral examination (20 minutes). The form of examination will be announced at the beginning of the semester
Usability: *General:* The module provides the foundations of estimation theory and applies the concepts to the estimation of parameters and the estimation of spectra. *Connection with other modules:* Estimation theory is one of the key techniques used in modern signal processing and communication systems. However, its applicability is not limited only to the field of electrical engineering, but it is used in any domain of engineering and science.

Course: Parameter Estimation
Module code: EITM 111I
Lecturer: Prof. Dr. Niclas Zeller
Contact hours: by arrangement
Semester of delivery: yearly, winter semester
Type/mode: lecture 2h/week; mandatory in the study field Information technology, optional in the other study fields of the program
Language of instruction: English or German; the course language will be announced at the beginning of the semester

Content: • properties of estimators • cost functions for estimators • principle of minimum mean square error • Gauß-Markov-theorem • implementation of an estimator as FIR-filter
Recommended reading: K. Kroschel: *Statistische Informationstechnik*, 4. Auflage, Springer, 2004 K.D. Kammeyer, K. Kroschel: *Digitale Signalverarbeitung, Filterung und Spektralanalyse*, mit MATLAB-Übungen, 6. Auflage, Teubner 2006
Comments: -

Course: Spectral Estimation
Module code: EITM 112I
Lecturer: Prof. Dr. Franz Quint
Contact hours: by arrangement
Semester of delivery: yearly, winter semester
Type/mode: lecture 2h/week; mandatory in the study field Information technology, optional in the other study fields of the program
Language of instruction: English or German; the course language will be announced at the beginning of the semester
Content: • DFT-based methods of spectral estimation • parametric models for random processes • AR-models, Yule-Walker-equation, Levinson-Durbin-recursion • spectral estimation and prediction • lattice filters, method of Burg • subspace models • methods of Pisarenko, MUSIC, ESPRIT
Recommended reading: S. M. Kay: *Modern Spectral Estimation*, Prentice Hall, 1988 S. M. Kay: *Fundamentals of Statistical Processing, Volume I: Estimation Theory,* Prentice Hall, 1993 P. Stoica, R. Moses: *Spectral Analysis of Signals*, Prentice Hall, 2005
Comments: -