EITM110I Signal Theory

Studiengang	Elektro- und Informationstechnik (Master)
Modulname	EITM110I Signal Theory
Zugeordnete Lehrveranstaltungen	EITM111I Parameter Estimation EITM112I Spectral Estimation
Studiensemester	1st semester
Modulverantwortlicher	Prof. Dr. Franz Quint
Dozenten	Prof. Dr. Franz Quint Prof. Dr. Joachim Stöckle
Sprache	English or German; the course language will be announced at the beginning of the semester
Lehrform, SWS und Gruppengröße	Course, 2h + 2h/week
Modus	Mandatory in the study field Information technology, elective in the other study fields of the program
Turnus	Winter semester
Arbeitsaufwand	On-campus program 60 h, self study 90 h
Kreditpunkte	5 CP
Empfohlene Vorkenntnisse	System Theory, Linear Algebra
Voraussetzungen nach Prüfungsordnung	none
Lernziele / Kompetenzen	*Allgemein:* The module provides the foundations of estimation theory and applies the concepts to the estimation of parameters and the estimation of spectra. *Zusammenhänge / Abgrenzung zu anderen Modulen:* 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. *Kenntnisse, Fertigkeiten, Kompetenzen:* 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
Inhalt	• properties of estimators • cost functions for estimators • principle of minimum mean square error • Gauß-Markov-theorem • implementation of an estimator as FIR-filter

	• 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
Studien- und Prüfungsleistungen	Assessment is done by either a written exam (90 minutes) or an oral examination (20 minutes). The form of examination will be announced at the beginning of the semester.
Medienformen	• course manuscript • slides (Powerpoint, PDF) • Matlab simulation programs • excersizes
Literatur	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 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