

Module: Digital Processing of Stochastic Signals

Level	Master	Short Name	DPSS
Responsible Lecturers	Prof. Dr. Ralph Hänsel		
Department, Facility	Electrical Engineering and Computer Science		
Course of Studies	Applied Information Technology, Master		
Compulsory/elective	Compulsory elective	ECTS Credit Points	5
Semester of Studies	2	Semester Hours per Week	4
Length (semesters)	1	Workload (hours)	150
Frequency	SuSe	Presence Hours	60
Teaching Language	English	Self-Study Hours	90

The following section is filled only if there is **exactly one** module-concluding exam.

Exam Type	Written Exam	Exam Language	German/English
Exam Length (minutes)	120	Exam Grading System	One-third Grades

Learning Outcomes	After successful completion of this course, the students will be able to: <ul style="list-style-type: none"> • Describe stochastic signals mathematically using expectations like the first and second moments of a stochastic process. • Represent stochastic signals in the time domain and the frequency domain and to classify them. • Apply the structure of digital systems for processing stochastic signals including two different predictor structures. • Describe and apply different adaptation strategies and be familiar to the design of adaptive filters. • Name typical applications of the presented systems. • Design predictors and quantizers for a given training sequence. • Make use of stochastic features of a given signal for data compression. • Describe the basic structures of different systems for source coding. 		
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Participation Prerequisites			
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The previous section is filled only if there is **exactly one** module-concluding exam.

Consideration of Gender and Diversity Issues	✓ Use of gender-neutral language (THL standard) ✓ Target group specific adjustment of didactic methods ✓ Making subject diversity visible (female researchers, cultures etc.)		
Applicability			
Remarks			

Module Course: Digital Processing of Stochastic Signals (Lecture)

(of Module: Digital Processing of Stochastic Signals)

Course Type	Lecture	Form of Learning	Presence
Mandatory Attendance	no	ECTS Credit Points	3
Participation Limit		Semester Hours per Week	3
Group Size		Workload (hours)	90
Teaching Language	English	Presence Hours	45
Study Achievements ("Studienleistung", SL)		Self-Study Hours	45
SL Length (minutes)		SL Grading System	

The following section is filled only if there is a course-specific exam.

Exam Type		Exam Language	
Exam Length (minutes)		Exam Grading System	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	<ul style="list-style-type: none"> • Cha. 1: IntroductionContent and organization of the course, features of stochastic signals, basic model of information transmission. • Cha. 2: Introduction to ProbabilityEvents, random variables and probability, discrete and continuous random variables, stochastic processes, autocorrelation function. • Cha. 3: PredictionBasic idea, structure of the predictor, derivation of the optimal prediction, the prediction gain, the Levinson Durbin-Algorithm, prediction with lattice filters. • Cha. 4: Adaptive FiltersWiener-filter , LMS-Algorithm, Kalman-Filter. • Cha. 5: QuantizationScalar quantization, companding, block quantization, Karhunen-Loeve-transform, vector quantization, the LBG-Algorithm. • Cha. 6: Principles of AdaptationForward adaption, backward adaptation, main and side information, constant and variable data rates. • Cha. 7: ApplicationsSource coding: RELP, DPCM, G.726(ADPCM), G.722 (SB-ADPCM),G.728 (LD-CELP), ETSI/ GSM Standard 06.10 (RPE-LTP), MP3, feature extraction, signal enhancement, echo cancellation, adaptive channel equalization, adaptive beam forming
Literature	In English:

- P.S.R. Diniz, Adaptive Filtering, Kluwer Academic Publishers, 2002, ISBN 1-4020-7125-6
- Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, 2002, ISBN 0- 0711-9981-0

In German:

- F.Jondral, A.Wiesler, Wahrscheinlichkeitsrechnung und stochastische Prozesse, Teubner Verlag, 2002, ISBN 3-5191-6263-6
- E.Hänsler, Statistische Signale Grundlagen und Anwendungen, Springer Verlag, 2001, ISBN 3-5404- 1644-7
- W.Hess, U.Heute, P.Vary Digitale Sprachsignalverarbeitung Teubner Verlag, Stuttgart, 1998, ISBN 3-519-06165-1, ISBN-13 978-3519061656
- J.F. Böhme, Stochastische Signale, Teubner Verlag, 1998, ISBN 3-5191-6160-5

Remarks

Module Course: Digital Processing of Stochastic Signals (Practical Training)

(of Module: Digital Processing of Stochastic Signals)

Course Type	Practical Training	Form of Learning	Presence
Mandatory Attendance	yes	ECTS Credit Points	2
Participation Limit		Semester Hours per Week	1
Group Size		Workload (hours)	60
Teaching Language	English	Presence Hours	15
Study Achievements ("Studienleistung", SL)	Practical Training	Self-Study Hours	45
SL Length (minutes)		SL Grading System	Pass

The following section is filled only if there is a course-specific exam.

Exam Type		Exam Language	
Exam Length (minutes)		Exam Grading System	
Learning Outcomes			
Participation Prerequisites			

The previous section is filled only if there is a course-specific exam.

Contents	To deepen and expand the practical knowledge the students will solve three problems out of a set of given problems using MATLAB on a PC. Topics are: Signal analysis and measurement of the autocorrelation function, adaptive gain control using the probability density function, design of a linear predictor for speech signals, programming an adaptive lattice predictor, implementation of the LMS-Algorithm.
Literature	See lecture
Remarks	