IMPORTANT NOTE:
This module handbook is preliminary, as the list of modules taught in English is still under development.

List of Modules

Master Computer Science

Department of Electrical Engineering and Computer Science

University of Siegen

Date: 24.02.17

Contents

Module name	**Algorithms I**
Module level	Master
Abbreviation (if any)	
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Markus Lohrey
Lecturer	Markus Lohrey
Module type	Core module
Module duration (semester)	1
Frequency	every winter semester
Recommended semester	starting from first semester of master course
Language	English
Teaching forms	lecture and turotials
Courses/labs (hours)	60
Self-studies (hours)	90
Workload (hours)	150
Credit points	5
Formal requirements for participation	none
Requirements for participa-tion with regard to content	Discrete Mathematics for Computer Scientists, Foundations of Theoretical Computer Science
Contents	divide-and-conque algorithms, greedy algorithms, dynamic programming, algorithms on strings, trees and graphs, sorting algorithms, basic data structures (e.g. search trees)
Intended learning results / competences	The students know basic techniques for the analysis of algorithms and algorithmic design principles and are able to apply these to concrete problems.
Examination type	oral exam to the content of the lecture
Requirement for awarding credit points	successful passing of the exam
Literature	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms (third edition). MIT Press 2009 Thomas Ottmann, Peter Widmayer, Algorithmen und Datenstrukturen (fifth edition). Springer 2012 Uwe Schöning, Algorithmik. Spektrum Akademischer Verlag 2001

Module name	**Computer Graphics II**
Module level	Master
Abbreviation (if any)	CG 2
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Prof. Dr. A. Kolb
Lecturer	Prof. Dr. A. Kolb
Module type	Core module
Module duration (semester)	1
Frequency	Summer semester
Recommended semester	starting from 4th semester in bachelor course starting from 1st semester in master course
Language	German/English
Teaching forms	Lecture 2 SWS, lab 2 SWS
Courses/labs (hours)	60
Self-studies (hours)	90
Workload (hours)	150
Credit points	5
Formal requirements for participation	
Requirements for participation with regard to content	Mathematics for Visual Computing, Computer Graphics I
Contents	Mediation of the extended fundamentals of generative 3D computer graphics with the focus on modeling complex geometries and animation. *Free-form curves and - surfaces *Polygon-meshes, winged-edge and half-edge representations *Modeling techniques *Sub-division surfaces *Keyframe animation, spline-based animation *Polynomial models, inverse kinematics *Procedural animation
Intended learning results / competences	*Students know different ways of describing geometrical forms and are skilled in handling them *Students can reproduce elementary algorithms of computer animation *Students can evaluate animation techniques and utilize them for specific assignments *Students can describe modeling techniques *Students know the main advantages and disadvantages of different modeling techniques and can evaluate and implement them for simple problems *Students can apply mathematical concepts practically
Examination type	written

Requirement for awarding credit points	Examination; successful processing of exercises is prerequisite for the examination
Literature	*Foley, van Dam, Feiner & Hughes. Computer Graphics. Addison Wesley, 1993 *Encarnacao, Strasser & Klein. Graphische Datenverarbeitung. Oldenbourg 1996 *Watt. 3D Computer Graphics. Addison Wesley 2000 *Shirley. Fundamentals of Computer Graphics. AK Peters 2005 *Bungartz, Griebel & Zenger. Einführung in die Computergraphik. Vieweg 1996

Module name	**Computer Graphics III**
Module level	Master
Abbreviation (if any)	CG 3
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Dr. Martin Lambers
Lecturer	Dr. Martin Lambers
Module type	Specialization module
Module duration (semester)	1
Frequency	Winter semester
Recommended semester	starting with the 1st semester
Language	German
Teaching forms	Lecture 2 SWS, lab 1 SWS
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	
Requirements for participa-tion with regard to content	Basic knowledge from B. CG-VC, Mathematics for VC, Computer Graphics I
Contents	This course imparts enhanced knowledge of Computer Graphics. The focus is on hardware acceleration and shading, realtime-rendering and photo realism. Topics covered in detail include: *Complex material models, BRDFs *Global illumination *Procedural texturing and modeling *Image based rendering, light fields *Point based rendering
Intended learning results / competences	*Students know the different concepts and specific algorithms of photo realistic image synthesis, and are able to choose and apply in practice adequate techniques, in simple contexts *Students know the basic principles of image based rendering, and know how to differentiate them against classical techniques of model based graphics. *Students know basic principles of global illumincation calculation and know how to implement them in simple contexts in practice *Students can develop simple GPU-programs for the creation of special graphic effects
Examination type	oral
Requirement for awarding credit points	oral examination

Literature	*Eberly. 3D Game Engine Design. Morgan Kaufman, 2006 *Ebert, Musgrave, Peachey, Perlin and Worley. Texturing and Modeling. Morgan Kaufman 2003 *Möller, Haines. Real-Time Rendering. AK Peters, 2008

Module name	**Computer Graphics IV**
Module level	Master
Abbreviation (if any)	CG 4
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Dr. Martin Lambers
Lecturer	Dr. Martin Lambers
Module type	Specialization module
Module duration (semester)	1
Frequency	Summer semester
Recommended semester	starting with the 2nd semester
Language	German
Teaching forms	Lecture 2 SWS, lab 1 SWS
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	
Requirements for participa-tion with regard to content	
Contents	Subject of this course is the programmnig of highly parallel processors, specifically graphic processors (GPUs), by means of graphic independent interfaces. No graphic knowledge is required. *General Purpose Computations on Graphics Processing Units (GPGPU) *Graphik independent interfaces for programming graphics processing units (CUDA, OpenGL, OpenACC) *Selected algorithms for highly parallel processors
Intended learning results / competences	Students know the principles of graphic independent usage of graphic processors (GPUs) as well as the properties of the necessary interfaces *Students can develop highly parallelized solutions for general problems on graphic processors *Students know the storage and processing concepts for modern GPUs *Students are able to develop simple programs in CUDA
Examination type	Oral
Requirement for awarding credit points	Oral examinatinon
Literature	*Möller, Haines, Hoffman. Real-Time Rendering. AK Peters, 2008 *Ausgewählte aktuelle Forschungspublikationen

Module name	**Convex Optimization for Computer Vision**
Module level	Master
Abbreviation (if any)	
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Prof. Michael Möller
Lecturer	Prof. Michael Möller
Module type	Specialization module
Module duration (semester)	1
Frequency	Summer semester
Recommended semester	1-3
Language	English
Teaching forms	Lecture with projector and black board, interactive elements, exercises
Courses/labs (hours)	90
Self-studies (hours)	210
Workload (hours)	300
Credit points	10
Formal requirements for participation	Master studies computer science (visual computing or theoretical informatics) or master studies mathematics
Requirements for participa-tion with regard to content	Solid knowledge of basic mathematics (analysis and linear algebra)
Contents	The following topics will be covered in this module: Convex analysis as the theoretical basis for all algorithms: - Convexity - Existence and uniqueness of minimizers - Subdifferentials - Convex conjugates - Saddle point problems and duality Numerical methods: - Gradient Descent - Proximal Gradient Descent - Proximal point algorithm - Primal-dual hybrid gradient method - Augmented Lagrangian methods - Acceleration schemes, adaptive step sizes, and heavy ball methods for the aforementioned methods Example applications in computer vision and signal processing problems: - Denoising, deblurring, image reconstruction - Depth reconstruction - Implementation of the above numerical methods for the example applications in Matlab

Intended learning results / competences	Upon completion of this module, students will be proficient in the practically relevant aspects of convex analysis. They are able to understand, apply and implement different numerical methods for convex optimization problems involving constraints and non-differentiable functions. The students are also able to reformulate energy minimization problems in a saddle-point and dual form. They will understand the convergence analysis of the proximal point algorithm and can apply the result to several other algorithms by deriving their proximal point form. Students will be able to solve convex optimization arising from standard computer vision problems on their own.
Examination type	exercises, oral exam
Requirement for awarding credit points	Reaching at least 50% of the points on the homework sheets is a requirement for being admitted to the oral exam
Literature	- Lecture notes. - Stephen Boyd, Lieven Vandenberghe. Convex Optimization. Cambridge University Press. 2003. - R. Tyrrell Rockafellar. Convex analysis. Princeton University Press. 1970. - Jean-Baptiste Hiriart-Urruty, Claude Lemaréchal. Fundamentals of convex analysis. Springer. 2004. - Yurii Nesterov. Introductory lectures on convex optimization. Kluwer-Academic. 2003. - Convex Analysis and Monotone Operator Theory in Hilbert Spaces. H. H. Bauschke and P. L. Combettes. 2011. - Jorge Nocedal, Stephen J. Wright. Numerical optimization. - Dimitri Bertsekas. Nonlinear programming. Athena Scientific. 1999. Further references to recent literature will be given in the lecture.

Module name	**Development of the Embedded Systems with FPGAs**
Module level	Master
Abbreviation (if any)	ES_FPGA
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Mohammed Abuteir
Lecturer	Mohammed Abuteir
Module type	Specialization module
Module duration (semester)	1
Frequency	Winter semester
Recommended semester	starting from 4th semester in bachelor course starting from 1st semester in master course
Language	English
Teaching forms	Lecture 2 SWS, lab 2 SWS
Courses/labs (hours)	60
Self-studies (hours)	90
Workload (hours)	150
Credit points	5
Formal requirements for participation	none
Requirements for participa-tion with regard to content	*Digital Design *Computer architecture I
Contents	Embedded system design using Vivado is the central topic of this course. This course gives the students the ability to learn the necessary skills to develop complex embedded systems using the Vivado design suite; understand and utilize advanced development techniques of embedded systems design for architecting a complex system in an All Programmable System on a Chip (SoC). Additionally, this course provides the necessary skills to develop ARM-based SoCs from high level functional specifications to design, implementation and testing on real FPGA hardware using standard hardware description and software programming languages. The particular topics to be covered are: • Introduction to Embedded System Design using Zynq • Zynq Architecture • Implementing Embedded Systems using Programmable Logic • Adding Your Own IP Peripheral • Software Development Environment and Debugging • System Debugging using Vivado Logic Analyzer and SDK • Memory Interfacing

	• Interrupts • Processor Configuration and Bootloader • Programming a Microblaze Processor
Intended learning results / competences	* Students know SoC architectures such as ZYNQ * Students know how to utilize the Hardware platform using development tools (e.g., Vivado) * Students know how to utilize the software platform (Software Development Kit) * Students get familiar with Zedboard and ZYBO Boards. * Students can apply hardware and software concepts practically at the end of the course.
Examination type	Oral
Requirement for awarding credit points	Examination; successful processing of exercises is prerequisite for the examination
Literature	* The zynq Book, Louise, Ross, Martin, Bob and David, August 2015 *Xilinx Tuturials, labs and data sheets.

Module name	**Machine Vision**
Module level	Master
Abbreviation (if any)	MaS
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Blanz
Lecturer	Blanz
Module type	Specialization module
Module duration (semester)	1
Frequency	Summer semester
Recommended semester	at least 5 if selected in Bachelor already
Language	English
Teaching forms	Lecture
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	none
Requirements for participa-tion with regard to content	Lineare Algebra
Contents	Camera Models (perspective projection, homogeneous coordinates), camera calibration, 3D depth reconstruction (trianglulation-based methods, structured light, phase-shift methods, spece-time-analysis), stereo vision (correspondence problem, auto-stereograms, triangulation from disparity, epipolar geometry, fundamental matrix, constrained stereo), multi-view geometry, reconstruction of objects with assumptions on parallel and orthogonal lines, image rectification, 3D face reconstruction using a morphable model, singular value decomposition and Moore-Penrose Pseudoinverse, Foundations of biometry and face recognition, Eigenfaces, PCA, Active Shape and Appearance Models, 2D and 3D Morphable Models, Evaluation techniques (error types, ROC), Elastic Graph Matching
Intended learning results / competences	Understanding the challenges of machine vision, judgement on which problems are easy to solve and which are hard or still unsolved, familiarity with some classical problems of machine vision and approaches to solve them, including a historical perspective of the development since the 80s, Knowledge of the theoretical foundations (camera models, projective geometry, image statistics), understanding of the most important techniques and ability to implement them
Examination type	Oral Exam

Requirement for awarding credit points	Ability to understand the characteristic challenges of different vision problems, to summarize the core ideas of the concepts and techniques covered in the lecture, to apply this knowledge and to use the mathematical formalism required for these concepts and ideas.
Literature	

Module name	**Numerical Basics of Simulation Techniques**
Module level	Bachelor
Abbreviation (if any)	
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Univ.-Prof. Dr.-Ing. Sabine Roller
Lecturer	Univ.-Prof. Dr.-Ing. Sabine Roller
Module type	Specialization module
Module duration (semester)	1
Frequency	Every semester
Recommended semester	5 - 6
Language	German / English
Teaching forms	Lecture 2 SWS, Lab 1 SWS
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	none
Requirements for participation with regard to content	
Contents	Basics of Simulation: Levels of Modeling Ordinary Differential Equations: Numerical Integration Partial Differential Equations and their Classification Development of the Finite Difference Method on Structured Grids Numerical Methods for Elliptical PDEs Solving of Linear Equation Systems Numerical Methods for Parabolic Differential Equations: Explicit and Implicit Methods Numerical Methods for Hyperbolic Differential Equations: Conservation Form Time-Step Extension Condition for Parabolic and Hyperbolic Methods Computational Grids Finite Volume Methods on Unstructured Grids Finite Element Methods on Unstructured Grids
Intended learning results / competences	* Students obtain an overview of numerical methods for the solution of differential equations and for the further steps necessary for simulations, such as grid definition and visualization. Basic numerics for regular and partial differential equations is treated in depth * Students are enabled to describe and explain the mathematical basics. They understand the connection between physical properties of an application, the mathematical properties of an equation and the appropriate choice of methods. This enables

	them, once employed, to choose appropriate software packages.
Examination type	Examination type is determined at the beginning of each semester and communicated to participants
Requirement for awarding credit points	Passed examination
Literature	* R. W. Hamming: Numerical Methods for Scientists and Engineers (2nd Edition). Dover Publications. 1987. * Alfio Quarteroni, Ricardo Sacco, Fausto Saleri: Numerical Mathematics. Springer. Texts in Applied Mathematics, Vol. 37; Springer 2nd edition 2007. * Lecture slides available via Moodle

Module name	**Parallelverarbeitung (Parallel Processing)**
Module level	Master
Abbreviation (if any)	PV
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Prof. Dr. Roland Wismüller
Lecturer	Prof. Dr. Roland Wismüller
Module type	Core module
Module duration (semester)	1
Frequency	Winter Semester
Recommended semester	1-3
Language	German/English
Teaching forms	Lecture (2 SWS) and practical exercises (2 SWS)
Courses/labs (hours)	60
Self-studies (hours)	90
Workload (hours)	150
Credit points	5
Formal requirements for participation	
Requirements for participation with regard to content	Programming skills in C/C++ or Java; Knowledge of basic Operating System concepts, esp. threads and synchronisation
Contents	Parallel processing is a basic technique to increase the performance and throughput of both hardware and software. This course communicates theoretical and practical knowledge of different techniques for parallel processing with a focus on practical applications. The module comprises a lab, where participants will autonomously parallelise small programs with different techniques. The lecture covers the following topics: * Basics: parallelism, architecture of parallel computers, strategies for parallelisation, data dependences * Parallel programming with shared memory: threads, OpenMP, parallel libraries and languages * Parallel programming with message passing: MPI * Performance estimation and optimization
Intended learning results / competences	Students can apply different techniques of parallel processing and can judge their specific strengths and weaknesses. They can solve practical problems with relevant standards, libraries and tools. For a given application, they can assess whether a parallelisation makes sense and if so, which techniques should be used. They can identify those parts of a given sequential program, which can be parallelised and can construct code for these parts. The students can apply relevant methods when designing parallel programs, especially during performance estimation, problem decomposition and the actual parallelisation.

Examination type	Oral examination
Requirement for awarding credit points	Examination; successful participation in the practical lab is required for being admitted to the exam
Literature	*Barry Wilkinson, Michael Allen. Parallel Programming, internat. ed., 2. ed. Pearson Education international, 2005 *A. Grama, A. Gupta, G. Karypis, V. Kumar. Introduction to Parallel Computing, 2. ed. Pearson Education, 2003 *Thomas Rauber, Gudula Rünger. Parallele und verteilte Programmierung. Springer, 2000 *Theo Ungerer. Parallelrechner und parallele Programmierung. Spektrum, Akad. Verl., 1997 *Ian Foster:. Designing and Building Parallel Programs. Addison-Wesley, 1995 *Seyed Roosta. Parallel Processing and Parallel Algorithms. Springer, 2000

Module name	**Pattern Recognition**
Module level	Master
Abbreviation (if any)	PR
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Marcin Grzegorzek
Lecturer	Marcin Grzegorzek
Module type	Specialization module
Module duration (semester)	1
Frequency	Summer semester
Recommended semester	starting from 1st semester in master course
Language	English
Teaching forms	Lecture 2 SWS, lab 1 SWS
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	
Requirements for participa-tion with regard to content	Very good knowledge in mathematics, very good programming skills
Contents	- Introduction and Outline - Classifiers Based on Bayes Decision Theory - Linear Classifiers - Nonlinear Classifiers - Feature Selection - Feature Transformation - Feature Extraction - Template Matching - Context-Dependent Classification - Clustering: Basics Concepts - Clustering Algorithms I: Sequential Algorithms - Clustering Algorithms II: Hierarchical Algorithms - Clustering Algorithms III: Schemes Based on Function Optimisation - Summary, Applications, and Conclusions
Intended learning results / competences	- Students know principles of supervised and unsupervised classification algorithms - Students can reproduce elementary supervised classification algorithms - Students can reproduce elementary clustering algorithms - Students can conceptualise, implement, and evaluate pattern recognition software for solving elementary classification problems
Examination type	Oral

Requirement for awarding credit points	Positive result of the oral examination
Literature	Sergios Theodoridis, Konstantinos Koutroumbas - “Pattern Recognition” - Academic Press

Module name	**Scientific Visualization**
Module level	Master
Abbreviation (if any)	VIS
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Prof. Dr. A. Kolb
Lecturer	Prof. Dr. A. Kolb
Module type	Specialization module
Module duration (semester)	1
Frequency	Winter Semester
Recommended semester	starting with semester 4 of the bachelor and 1 of the master course
Language	German
Teaching forms	Lecture: 2 SWS; Lab: 1 SWS
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	
Requirements for participa-tion with regard to content	Basic knowledge of B. Inf-VC; mathematics for VC, Computer Graphics I
Contents	The Visualization lecture treats the visual representation of spatial scientific simulation and measuring data of medicine, natural science and technology. The focus is on interactive illustration techniques of abstract data fields on displayable geometries. The following topics are covered in depth: *Grid types and interpolation *2D scalar fields *Vector field topology and particle paths *2D and 3D flow visualization *Direct and indirect volume visualization
Intended learning results / competences	*Students know the various concepts and specific algorithms of scientific visualization *Students are able to practically implement and apply selected visualization techniques *Students can choose and apply appropriate visualization techniques for a given problem in simple situations
Examination type	Oral
Requirement for awarding credit points	Examination; successful processing of exercises is prerequisite for the examination

Literature	*C. Hansen, C. Johnson. The Visualization Handbook. Elsevier Academic Press, 2005 *K. Engel, M. Hadwiger, J. Kniss, R. Rezk-Salama, D. Weiskopf. Real-Time Volume Graphics. AK Peters, 2006 *Tagungsbände IEEE Visualization. www.ieee.org

Module name	**Statistical Learning Theory**
Module level	Master
Abbreviation (if any)	StL
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Blanz
Lecturer	Blanz
Module type	Specialization module
Module duration (semester)	1
Frequency	Summer semester
Recommended semester	at least 5 if selected in Bachelor already
Language	English
Teaching forms	Lecture
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	none
Requirements for participa-tion with regard to content	Lineare Algebra, Machine Vision
Contents	Definition of the Problem of Learning, Induction, Foundations of Stochastics and Statistics (Conditional Probability, Bayes Theorem, Expectation Values, Variance, Normal Distribution, arithmetic mean, maximum a posteriori methods), linear regression, artificial intelligence and neural networks, principal component analysis, fishers linear discriminant, Support Vector Machines (VC dimension, structural risk minimization, linear soft-margin classifiers, constrained optimization with lagrange multipliers, kernel methods, non-linear SVM, kernel-PCA)
Intended learning results / competences	Make students familiar with state-of-the-art methods in statistical learning as versatile tools for their carreer in research and development. The focus is to teach the fundamental problem settings, the benefits and challenges of different approaches, so students are able to recognize potential applications of machine learning and to choose appropriate methods. An in-depth knowledge of approaches such as neural networks and Support Vector Machines that would allow students to implement these algorithms from scratch are desired, but not the primary task of the course.
Examination type	Oral Exam
Requirement for awarding credit points	Ability to summarize the core ideas of the concepts and techniques covered in the lecture, to apply this knowledge and to use the mathematical formalism required for these concepts and ideas.

Literature	*V. Vapnik. The Nature of Statistical Learning Theory. Springer 1999 *Duda, Hart, Stork. Pattern Clasification, 2ed. Wiley 2001 *B. Schölkopf, A. J. Smola. Learning with Kernels. MIT Press, 2002.

Module name	**Telematics Multimedia**
Module level	Master
Abbreviation (if any)	TE MM
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Rainer Brück
Lecturer	Kai Hahn
Module type	Specialization module
Module duration (semester)	1
Frequency	Winter semester
Recommended semester	1-3
Language	English
Teaching forms	Lecture
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	none
Requirements for participation with regard to content	Basic knowledge of network technology (Computer Networks) and digital technology e.g. Lecture: Digital technology
Contents	The lecture content deals initially with the physiological and psychological abilities of humans and the resulting constraints for coding the multimedia data. At the beginning there is a summary of the communication bases. The historical foundations of multimedia data include inter alia typographic basics, fonts etc. Basics of vision and color reception are preparing for the raster image data formats. The human ability to hear and psychoacoustics form the audio basics. Building on that audio data formats and compression methods are discussed. The classical (analog) video technology is the initial consideration for digital video compression. MPEG, multimedia encryption standards, as well as the transfer of media content with digital wideband audio / video transmission methods such as DVB. The media law and media economics illuminate the social and economic implications of telematics in the multimedia field
Intended learning results / competences	Knowing the History of Multimedia Deriving needs for media data formats from human senses abilities Assessing the capabilities of multimedia data Applying basic compression ideas on different media types Understanding lossy compression with regard to psycho-acoustics and psycho-optics
Examination type	oral

Requirement for awarding credit points	exam
Literature	Taschenbuch Multimedia, Hanser-Verlag

Module name	**Telematics Technologies and Applications**
Module level	Bachelor
Abbreviation (if any)	TE TuA
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Rainer Brück
Lecturer	Kai Hahn
Module type	Specialization module
Module duration (semester)	1
Frequency	Summer semester
Recommended semester	1-3
Language	German/English
Teaching forms	Lecture
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	none
Requirements for participa-tion with regard to content	Basic knowledge of network technology (Computer Networks) and digital technology e.g. Lecture: Digital technology
Contents	Telematic technologies part include * Modelling of telecommunication systems * Internet, mobile communications, satellite services * Public telecommunications networks, standardization process * Telematics hardware, medical sensor * Physiological and psychological basics the subsequent Telematics Applications part include: * E-Commerce, Electronic Markets / Marketing, Technical Infrastructure, M-Commerce, payment systems, security, Legal framework, logistics - RFID for trade issues, * Traffic telematics applications Individual traffic, technologies (GPS, DAB ..) * Tele surgery, clinical information systems, electronic medical card * Multimedia Electronic Patient Record, data cards in healthcare, network-based services * Telemedicine in medical care, public health information for consumers and patients * Cost / Benefit Ratio for the doctor and patient, Technological framework Legal framework

Intended learning results / competences	Knowing the History of Telecommunication Understanding the layer model of communication systems Assessing the capabilities of tethered an radio-based communication means Applying basic ideas to areas like e-Commerce, traffic, and medicine Understanding opportunities and limitations of current and future telecommunication
Examination type	oral
Requirement for awarding credit points	exam
Literature	Lehr- und Übungsbuch Telematik: Netze - Dienste - Protokolle, Hanser-Verlag

Module name	**Ubiquitous Computing**
Module level	Master
Abbreviation (if any)	UC
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Prof. Dr. Kristof Van Laerhoven
Lecturer	Prof. Dr. Kristof Van Laerhoven
Module type	Specialization module
Module duration (semester)	1
Frequency	Every Semester
Recommended semester	1-3
Language	German/English
Teaching forms	Lecture (2 SWS) with practical exercises (2 SWS)
Courses/labs (hours)	60
Self-studies (hours)	90
Workload (hours)	150
Credit points	5
Formal requirements for participation	
Requirements for participation with regard to content	
Contents	This lecture gives an overview on relevant concepts and technologies (such as the history of ubiquitous computing and underlying visions, embedded systems and cyber-physical systems, mobile computing, wearable computing, and wireless sensor networks). It will also deal with more specific subjects (e.g., context awareness, activity recognition, privacy and security issues, research methods in this emerging field). Case studies will also be given during breaks to give more insights in current developments and the lessons and pitfalls that researchers and engineers have met while deploying such novel systems.
Intended learning results / competences	After following this course, students will be able to orient themselves in research and development projects that involve novel computing systems such as wireless sensor networks and wearables. The exercises will make the students familiar with the latest tools and methods to prototype and develop software for these systems, as well as experiment and set up user studies.
Examination type	Oral exam
Requirement for awarding credit points	
Literature	lecture slides plus: Mark Weiser, The computer for the 21st century

Module name	**Variational Methods for Computer Vision**
Module level	Master
Abbreviation (if any)	
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Prof. Michael Möller
Lecturer	Prof. Michael Möller
Module type	Specialization module
Module duration (semester)	1
Frequency	Winter semester
Recommended semester	1-3
Language	English
Teaching forms	Lecture with projector and black board, interactive elements, exercises
Courses/labs (hours)	90
Self-studies (hours)	210
Workload (hours)	300
Credit points	10
Formal requirements for participation	Master studies computer science (visual computing)
Requirements for participa-tion with regard to content	Solid knowledge of basic mathematics (analysis and linear algebra)
Contents	The following topics will be covered in this module: - Basic image representations (discrete/continuous) - Important practical applications in image processing and computer vision, including - Denoising - Deblurring - Super Resolution - Inpainting - Demosaicking - Segmentation - Stereo Vision - Optical Flow - 3D Reconstruction - Regularization methods such as TV, TGV, nonlocal methods and dictionary based regularizations - Basic mathematical concepts for variational method - Gradient descent methods to determine minimizers - Numerical implementation of the aforementioned applications in Matlab

Intended learning results / competences	Upon completion of this module, students will be proficient in the practically relevant aspects of formulating several computer vision problems as energy minimization problems. In particular, they are able to state standard variational methods for denoising, deblurring, super resolution, demosaicking, segmentation, stereo reconstruction, optical flow estimation, and 3D reconstruction. Students are able to formulate energies whose minimizers yield solutions to the aforementioned problems. Students can implement simple numerical methods such as the gradient descent algorithm on their own.
Examination type	exercises, oral exam
Requirement for awarding credit points	Reaching at least 50% of the points on the homework sheets is a requirement for being admitted to the oral exam
Literature	- Lecture notes. - K. Bredis, D. Lorenz, „Mathematische Bildverarbeitung: Einführung in Grundlagen und moderne Theorie“, Vieweg & Teubner 2011. - P. Kornprobst, G. Aubert, „Mathematical Problems in Image Processing, Partial Differential Equations and the Calculus of Variation“, Springer 2006 - T. Chan, J. Shen, “Image Processing and Analysis: Variational, PDE, Wavelet, and Stochastic Methods”, SIAM 2005. - J.-M. Morel, S. Solimini, „Variational Methods in Image Segmentation”, Birkhäuser 1995. Further references to recent literature will be given in the lecture.

Module name	**Virtual Reality**
Module level	Master
Abbreviation (if any)	VR
Subtitle (if any)	
Courses (if appropriate)	
Responsible person	Prof. Dr. A. Kolb
Lecturer	Prof. Dr. A. Kolb
Module type	Specialization module
Module duration (semester)	1
Frequency	Summer semester
Recommended semester	starting with semester 2 of the master course
Language	German
Teaching forms	Lecture: 2 SWS; Lab: 1 SWS
Courses/labs (hours)	45
Self-studies (hours)	105
Workload (hours)	150
Credit points	5
Formal requirements for participation	
Requirements for participa-tion with regard to content	Basic knowledge of B. Inf-VC; mathematics for VC, Computer Graphics I
Contents	Virtual Reality is a area which finds application in the human-technology interaction. Participants will be enabled to apply the field of Computer Graphics in the application area VR, and to create problem specific hardware configurations. *Basics, particularly immersion, control flow, components of a VR application *Human perception, eye, ear, sensory perception *VR-hardware: Display devices, motion capturing, input devices, feedback, acoustic feedback *Special aspects of Computer Graphics: Stereo projection, mesh streaming and reduction, LODs *Interaction, rigid-body simulation and collision recognition *Special VR-software environments
Intended learning results / competences	*Students know the important properties of human perception and the particular challenges presented by the creation of sensory stimuli in VR environments. (Image, sound) *Students know the various hardware concepts in the area of display and interaction and are able to choose appropriate software components for simple problems *Students know software concepts and specific algorithms, which are of particular importance in the area of Virtual Reality (particularly stereo-image-creation, LODs) and are able to implement and apply them in programming. *Students know the software packages which are used as

	examples in the VR-Lab of the University of Siegen, and can begin to create simple extensions.
Examination type	Oral
Requirement for awarding credit points	Examination; successful processing of exercises is prerequisite for the examination
Literature	*D. Eberly. 3D Game Engine Design. Morgan Kaufman, 2001 *A. Watt, F. Policarpo. 3D Games. AddisonWelsley, 2001 *J. Vince. Introduction to Virtual Reality. Springer London, 2004 *G. Burdea und Ph. Coiffet. Virtual Reality Technology. Wiley, 2003