

Teaching portfolio

1. Teaching CV: A list of any lecturing and supervision tasks, including specification of academic fields, scope, level (bachelor, master, continuing education, PhD) as well as any external examiner tasks.

Lecturing: Nonlinear Control & Servo Systems I have been responsible for the entire course in autumn 2015, including coordinating, planning and preparation of the course, part of the related literature, lectures as well as the course examination. Furthermore, I was responsible for four lectures of this course in autumn 2014. The course is offered to students at their 3rd graduate semester (their 9th semester in total), and is concerned with providing the students with skills in the field of nonlinear systems, their analysis and control. The scope of the course includes the following topics: • Introduction to nonlinear systems - common features & comparison with linear systems. • Concepts of stability: Stability, asymptotic-, exponential- and finite-time stability & limit cycles. • Construction of phase portraits for 2nd order systems & phase plane analysis. • Lyapunov theory: Stability analysis using Lyapunov's direct method. Linearization & local stability. • Invariant set theorems & Lyapunov-like analysis. • Tools for mathematical analysis of discontinuous systems & homogeneity properties. • Design of stable adaptive systems. • Design of 1st & 2nd order sliding mode control systems as well as their smooth counterparts. Multi-Variable & Nonlinear Control Methods I have been responsible for a part of this course in spring 2015 and spring 2016, encompassing planning, preparation and conduction of several lectures of the course, as well as participated in the course examination. The course is mandatory for students at their 2nd graduate semester at several study programmes under the energy study board. The course is primarily concerned with the field of multi-variable linear systems, their analysis and control. This field is very broad and is initiated with extensive recapitulation of some of the dominant state space control design methods in the field of single-input-single-output (SISO) systems. The scope of the course include the following topics: • Introduction to multi-variable systems. • Pole placement design & observer design for single-input-single-output systems. • Concepts of stability. • Disturbance models. • Analysis of cross-couplings through relative gain array (RGA) methods & singular value decomposition (SVD). • Design of decoupling controllers. • Design of internal model controllers (IMC). • Design of linear quadratic controllers (LQR). • Control design limitations. Fundamentals of Sliding Mode Control This course may be considered an ad hoc course that was conducted besides the curriculum, to facilitate student projects in this field. The course was mainly intended to provide the students with the necessary basic competence in order for them to be able to work with such- and related topics. • The scope of the course include the following topics: • Mathematical background and tools for use in the analysis of discontinuous dynamical systems. • Definition and discussion on conventional (first order) and higher order sliding modes, and their utilization in control of dynamical systems. • Discussion on possible methods to overcome control chattering when implementing discontinuous controllers in systems with actuator dynamics. Co-Teaching Experience: Fundamental Control Theory I have been co-teaching the course Fundamental Control Theory in the spring of 2015. The course contain the following main topics. • Modeling of dynamical systems & linearization. • Laplace transformation, block diagrams & transfer functions. • Transient responses of 1st, 2nd & 3rd order systems. Transient design specifications. • Stability & stationary response analysis: Routh's stability criteria & characteristic equation, stationary errors & system types. • Root locus analysis & sketching. • Control design via root loci - lead, lag & lag-lead controllers. • Frequency response analysis. Stationary output to sine inputs. Introduction to Bode diagrams. • Polar plots & Nyquist stability criteria. Stability & relative stability - open & closed loop frequency response. • Control design in the frequency domain - lag, lead & PID control design Optimization Theory I co-taught this course in the spring of 2013. The course covered the following topics. • Standard linear programming problems. Basic concepts. Basic ideas and steps in the Linear Simplex method. Post-optimality analysis. • Alternate form of KKT necessary conditions, Irregular points. 2nd order conditions for constrained optimization. Linearization of constrained problem. Sequential Linear programming algorithm. Adaptive move limits. Introduction to Quadratic programming. • Quadratic programming. Constrained steepest descent method. Approximate step size determination. Constrained Quasi-Newton methods. Discrete variable concepts and methods: Branch and Bound method, integer programming, simulated annealing, dynamic rounding. • Genetic algorithms (GAs): basic concepts and fundamentals of GAs. Multi-objective optimum design concepts and methods. Criterion and design space. Pareto optimality. Multi-objective GAs. Selection methods. Supervision Experience My supervision tasks have primarily been concerned with graduate projects, and the specific projects are outlined below. At this point, I have been supervising 22 student projects. 10th Semester graduate projects (master theses) Spring 2015 Control and Exp. Evaluation of Speed-variable Switched Diff. Pump Concept Spring 2014 Development of Control Strategies for the Speed-variable Diff. Pump Concept Spring 2014 Analysis and Validation of a Generic 3D Dynamic Simulation Model Spring 2014 Modeling and Control of a Speed Variable Differential Pump System Concept Spring 2013 Higher Order Sliding Mode Control and Observers in Hydraulic Applications Spring 2013 Realizing 3rd Order Sliding Mode Control for a Hyd. Multi-body Servo System Spring 2013 Modeling and Control of 4 DOF Electro-Hydraulic System Spring 2013 Development of a Speed variable Differential Pump Concept Spring 2012 Adaptive Backstepping Control of Asym. Electro-Hydraulic Actuator System Spring 2011 Friction Modeling and Parameter Estimation for Hyd. Asymmetric Cylinders 9th Semester Graduate Projects Autumn 2014 System Optimization of New Speed-variable Differential Pump Concept Autumn 2014 Lyapunov Function for Modified Super Twisting Controller Autumn 2013 Simulation Study & Control of a Speed-variable Differential Pump System Autumn 2013 Single Blade Instal. in High Wind Speeds - Test Setup Design and Production Autumn 2012 Higher Order Position Sliding Control of Electro-Hyd. Asym. Cylinder Drive 7th Semester Graduate Projects Autumn 2015 Design & Evaluation of a SMI-SMO Control Strategy for a Hyd. Diff. Cylinder Autumn 2015 Separate-Meter-In-Separate-Out Based Control of a Hydraulic Actuator Autumn 2015 Hydraulic Servo Robot Autumn 2011 Trajectory Control of a Hydraulic Planar Elbow Servo Robot

2. Study administration: A list of any study administration tasks, e.g. study board membership, head of studies or semester or course coordinator, accreditation, etc.

Type your answer here...

3. University pedagogy qualifications: A list of any completed courses in university pedagogy, PBL courses, workshops, academic development projects, collegial guidance and supervision, etc.

Assistant Professor Course

4. Other qualifications: Conference attendance, editorials, presentations, etc. relating to education, 'University Teaching Day', etc.

Type your answer here...

5. Teaching activity development and teaching materials: A list of any contributions to the development of new modules, teaching materials, study programmes, e-learning, collaboration with external business partners, etc.

Type your answer here...

6. Teaching awards you may have received or been nominated for.

Type your answer here...

7. Personal reflections and initiatives: Here you may state any personal deliberations as regards teaching and supervision, any wishes and plans for further pedagogic development, plans for following up on feedback/evaluations from students, etc.

Type your answer here...

8. Any other information or comments.

Type your answer here...