

Undervisningsportfolio

1. Undervisnings-CV: Oversigt over undervisnings- og vejledningsopgaver med angivelse af fagområder, omfang, niveau (BA, kandidat, EVU, Ph.d) samt evt. censoropgaver.

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

5th Semester Undergraduate Project

Autumn 2015 Stabilization of Hydraulic Crane

4th Semester Undergraduate Project

Spring 2015 Control of Electro-Mechanical Positioning System
 Spring 2015 Control of DC-servomotor Actuating a Flexible Load

2. Studieadministration: Oversigt over studieadministrative opgaver, eksempelvis medlem af studienævn, studieleder, semesterkoordinator, fagkoordinator, akkreditering m.v.

Skriv dit svar her...

3. Universitetspædagogiske kvalifikationsforløb: Oversigt over gennemførte universitetspædagogiske kursusforløb, PBL-kurser, workshops, udviklingsprojekter, kollegial supervision o.l.

Adjunktpædagogikum

4. Anden form for kvalificering: Konferencedeltagelse, debatindlæg, oplæg m.v. i relation til uddannelse, "Undervisningens dag", o.l.

Skriv dit svar her...

5. Undervisningsudviklingsforløb og undervisningsmateriale: Oversigt over medvirken til udvikling af nye moduler, undervisningsmateriale, uddannelser, e-learning, samarbejde med eksterne samarbejdspartnere o.l.

Skriv dit svar her...

6. Nominering til og/eller modtagelse af undervisningspriser.

Skriv dit svar her...

7. Evt. personlige refleksioner og initiativer: Personlige overvejelser knyttet til undervisning og vejledning, ønsker til og planer for pædagogisk videreudvikling, planer for opfølgning på undervisningsevalueringer m.v.

Skriv dit svar her...

8. Andet.

Skriv dit svar her...