Ex. PGS 1060

TTK 4190 Guidance and Control of Vehicles

The course is given both Spring and Fall 2014, and then only in the Fall semester

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Lectures Spring 2014: Tuesday 08:15-11:00 (Room: EL1)
Assignment guidance: Thursday 16:15-18:00 (Room: F2)

Instructor Spring 2014: Morten D. Pedersen (E-mail: morten.d.pedersen@ntnu.no)
Instructor Fall 2014: Thor I. Fossen (E-mail: tif@itk.ntnu.no)
Student Assistant: Lorenzo Fusini (E-mail: lorenzo.fusini@itk.ntnu.no)

NTNU students, please use It's learning for communication and educational materials.

Description: Methods for design and implementation of guidance, navigation, and control (GNC) systems for ships, semi-submersibles, underwater vehicles, aircraft and unmanned vehicles (AUV and UAV). This includes simulation and testing of motion control systems during failure situations and for varying environmental loads. This covers 6-DOF mathematical modeling of vehicles and the environment (waves, ocean currents and wind). Emphasis is placed on kinematics (Euler angles and unit quaternions), rigid-body kinetics, hydrostatics, hydrodynamics, aerodynamics and vectorial mechanics. Applied control theory and synthesis in terms of linear-quadratic optimal control and state estimation (Kalman filtering), nonlinear observer theory, MIMO PID control with extensions to nonlinear systems, Lyapunov methods, sliding-mode control, feedback linearization, backstepping designs, passivity, and observer-based feedback. Observers for integration of global navigation satellite systems (GNSS) and inertial measurements (gyros and accelerometers), observer-based feedback, and observers for global navigation satellite systems (GNSS) and inertial measurement units.

Mandatory Text:
Fossen, T. I. (2011). »*Handbook of Marine Craft Hydrodynamics and Motion Control*». John Wiley & Sons Ltd.
Fossen, T. I. (2013). »*Mathematical Models for Control of Aircraft and Satellites*». Department of Engineering Cybernetics, April 2013.

- Lecture notes (http://www.itk.ntnu.no/fag/gnc/Wiley/slides.html)
- Errata (http://www.itk.ntnu.no/fag/gnc/Wiley/errata.pdf) for the «Handbook of Marine Craft Hydrodynamics and Motion Control»
- Literature (http://www.itk.ntnu.no/fag/gnc/pensum.htm)
- Exams with solution sets (http://www.itk.ntnu.no/fag/gnc/exams.html)
- Matlab and Simulink scripts (http://www.itk.ntnu.no/fag/gnc/matlab.htm)
- MSS toolbox at www.marinecontrol.org (http://www.marinecontrol.org)

Prerequisites: TTK 4105 Control Engineering (http://www.ntnu.edu/studies/courses/TTK4105#tab=omEmnet). It is recommended to have some background on Lyapunov stability theory (for instance Ch. 4 in Nonlinear Systems by Hassan K. Khalil, Prentice Hall, 2002 or TTK 4150 Nonlinear Control Systems (http://www.itk.ntnu.no/fag/TTK4150/) or similar.

Assignments: The assignments are mandatory. Details are given on *Itslearning*. Note that the assignments count for 30 % of the grade while the final exam counts for 70 % of the grade.

The problems sets are not mandatory. Solutions to these will be made available after the lecture.

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