TTK4190 - Guidance and Control of Vehicles

Assignment Overview and Practical Information

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Outline

About me

Work

- PhD student at the Department of Engineering Cybernetics since the fall of 2018
- Sea-State and Ship Response Estimation
- Many topics in this course are relevant to my PhD

Experience

- Took the course in 2016
- Student assistant (studass) in 2017

Contact Info

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Key Information

Portfolio Evaluation

- 70% of your final grade is decided by a written exam scheduled to be the 20th of December
- The remaining 30% is decided by a midterm exam scheduled the 14th of October
- Three mandatory computer assignments must be approved to get access to the final exam

Important Exam Info

Even though the course uses a portfolio evaluation you must pass all parts to get the portfolio grade. In other words, you need to pass the midterm exam and get a score above 41% on the final exam to pass this course

Key Information

Computer Assignments

- Three computer assignments will be published during the semester and each assignment must be approved in order to get access to the final exam
- The assignments must be handed in before the given deadlines to get approval
- The assignments cover different topics from the curriculum and are relevant for both the midterm and final exam

Getting access to the final exam

- Pass the midterm exam
- Get all computer assignments approved

Tutorial Session

Time

Assignment guidance is available on Mondays between 12:15-14:00 in KJL2 unless otherwise stated on Blackboard

- No assignment guidance today
- Student assistants and sometimes the teaching assistant will be present to help you with the assignments/other topics
- There will be at least two sessions with assignment guidance for each assignment
- Check Blackboard regularly as the calendar may change

New book

- Part One *Marine Craft Hydrodynamics* will be lectured from the newest edition i.e., Fossen (2020)
- Part Two *Motion Control* will be lectured from the first edition i.e., Fossen (2011)
- Both editions are available on Blackboard

Computer Assignments

Timetable

Assignment 1

- Published: Friday 30th of August
- Deadline: Monday 16th of September

Assignment 2 (Most likely dates)

- Published: Friday 20th of September
- Deadline Part 1: Monday 7th of October (1 week before the midterm exam)
- Deadline Part 2: Monday 4th of November

Assignment 3 (Most likely dates)

- Published: Friday 11th of October
- Deadline: Monday 18th of November

Computer Assignments

Topics

Assignment 1

- Kinematics, kinetics, control design and introduction to path following

Assignment 2

- Part 1: UAV autopilot design and some other topics from Beard & McLain
- Part 2: Estimation using Kalman Filtering

Assignment 3

- Modeling and control design of a surface ship
- LOS path-following
- Covers several topics from the curriculum

Computer Assignments

Cooperation

- You are supposed/encouraged to do the assignments in groups of 2-4 people, but can do the assignment individually if that is preferred
- Start early - the workload can be quite heavy!
- Group registration on Blackboard will be available when assignment 1 is published (Friday)
- It is possible to change group during the semester, but it is recommended to keep the same group

Computer Assignments

Structure

- The assignments usually have theoretical parts with questions/deductions and parts where you need to do simulations in Matlab
- Example: Use some sort of control design to prove that a controller gives closed-loop stability and simulate the control law in Matlab

Delivery

- The assignments should be delivered as a written report on Blackboard (PDF file)
- Only one person in the group needs to hand in the report
- It is not necessary to deliver Matlab files, but you may be asked to show them if you have suspicious/weird results

Computer Assignments

Written Report

- Strongly recommend LaTeX (a LaTeX template for assignment 1 will be published)
- Answer every problem properly and remember to answer all parts of the problem
- You are expected to be able to identify the importance of the results and discuss the most important findings
- Remember to read the questions carefully
- Usually it is possible to extract important information about the results you can expect by comparing the problem formulation for different problems

Computer Assignments

Evaluation

- Each assignment is evaluated as either passed or failed (no grade)
- Each participant in the group receives the same evaluation
- You need to get approximately 60% correct to pass and we are normally quite nice when marking the assignments
- Try to answer the entire assignment
- Your job is to convince us that you have understood the problems sufficiently
- Minor mistakes are accepted as long as you show us that you have understood the most important topics

Computer Assignments

Evaluation - 2

- In some problems we ask for specific figures $\rightarrow$ always include them
- You are expected to attach other figures if that is important for the discussion/results
- Only attach figures that are relevant for the current problem or later comparisons

Solution

- Draft solutions of the assignments are *not* going to be published
- The teaching assistant will present a solution for each assignment in the tutorial session after the deadline

Problem sets

- Voluntary problem sets related to the chapters in the curriculum are going to be posted along with the solutions on Blackboard
- The problem sets are relevant for the exam
- Would recommend to look through some old exams quite early, just to get a feel for the type of questions that can appear
- The assignments will not cover the entire curriculum so you need to read the book (and do additional problems) to do well on the exam

Midterm exam

Time

The midterm exam is scheduled to be Monday 14th of October at 12:15

Location

Decided closer to the exam by the administration

- The midterm exam accounts for 30% of the final grade

Curriculum

The chapters on the Lecture plan from Beard & McLain (ch. 2-7 and 10.1)

Midterm exam

Type of Exam

- The midterm exam is a digital exam
- No book allowed

Type of questions

- A part of the midterm exam consists of multiple choice questions
- The remaining part consists of written questions
- Try to answer every question

Evaluation

- The midterm exam is evaluated before the final exam

Sample questions

A set of examples for the type of questions on the midterm exam will be published closer to the exam

Midterm exam

Multiple choice example

What is the most correct equation for the sideslip angle in absence of wind and when only considering horizontal motion (3-DOF)?

1. $\beta = \sin^{-1}\left(\frac{v_r}{\sqrt{u_r^2+v_r^2+w_r^2}}\right)$
2. $\beta = \cos^{-1}\left(\frac{v_r}{\sqrt{u_r^2+v_r^2+w_r^2}}\right)$
3. $\beta = \sin^{-1}\left(\frac{v}{\sqrt{u^2+v^2}}\right)$
4. $\beta = \cos^{-1}\left(\frac{v}{\sqrt{u^2+v^2}}\right)$

Written question example

Explain why we need to represent the velocity of UAVs in different coordinate frames (ground speed, body-fixed velocity, air speed)?

Final exam

Time

The final exam is scheduled to be Wednesday 20th of December at 09:00

Place

Decided closer to the exam by the administration

- The final exam accounts for 70% of the final grade

Curriculum

The chapters from the book by Fossen (2011 and 2020) (see lecture plan)

Final exam

Type of Exam

The final exam is an open-book written exam

- You can bring the books, assignments, problem sets and lecture notes to the final exam

Type of questions

- Written questions (proofs, deductions, control parameter derivations and so on)

Sample questions

Old exams are already available on Blackboard

- Note that old exams often include questions from the aircraft book
- You can still get topics from the aircraft book on the final exam, but the topics will then be covered in Fossen as well

Forum

- A forum on Blackboard will be available soon where you can discuss assignments, problem sets and the exams
- The teaching staff will try and answer questions, but the forum is mainly intended for you (students) to discuss problems among each other

Advise for the semester

- Attend tutorial sessions to get help with challenging topics
- Do the assignments properly - they are very relevant for the exam
- Become familiar with the books (Fossen, Beard & McLain)
- Study old exams quite early and look for common topics
- Before attending lectures, try to look through some the material in advance
- Ask questions

Any questions?

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