



GMPE340

Kalman Filter and Sensor Integration

Information

The course will be presented in a hybrid version containing both classical lectures on Campus and digital lectures on Zoom.

Lectures/Exercises

Day	Time
Monday	1215 - 1400
Tuesday	1015 - 1200
Thursday	1415 - 1600

First lecture will be on Tuesday September 8. 2020, 1015-1200, BT3A16 / Zoom

Course contents

Introduction to stochastic processes and applied Kalman filtering with focus on positioning, navigation and time applications (PVT).

Learning outcome

Students will understand the basic filter derivation based on minimum variance. This is followed by various approaches to basic theory such as information filtering, suboptimal analysis, Bayesian estimation, ratio of least squares (LSQ) and other estimates, smoothing and methods for dealing with non-linearities.

Learning activities

Lectures, Colloquium, Student presentations, Assignments.

Prerequisites

Calculus and linear algebra. Differential equations. Parameter estimation

Recommended

Good programming skills (Python / MATLAB)

Syllabus

1. Brown, R., Hwang, P. - Random Signals and Applied Kalman Filtering 4th edition.
2. Selected Journal Papers

Mandatory activities

Selected exercises. Compulsory submissions must be passed in order to sit for the exam

Course responsible

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Table 1: Schedule

Date	Lecture	Responsible	Subject	Literature	Exercises
08.09	1	JGG	Introduction to Jupyter Notebook/Lab	Ch. 1	
	2	JGG			
10.09	3	JGG	Exercise	Ch. 1	Pr. 1.1, 1.2, 1.4, 1.9 and 1.10
	4	JGG			
14.09	5	JGG	Probability and Random Variables	Ch. 1	
	6	JGG			
15.09	7	JGG	Cancelled		
	8	JGG			
17.09	9	JGG	Exercise		Pr. 1.13, 1.14, 1.15 1.22, 1.27 and 1.28
	10	JGG			
21.09	11	JGG	Exercise		
	12	JGG			
22.09	13	JGG	Mathematical Descriptions of Random Signals	Ch. 2	
	14	JGG			
24.09	15	JGG	Exercise		Pr. 2.1, 2.2, 2.3 2.9 and 2.12
	16	JGG			
28.09	17	JGG	Linear Systems Response	Ch. 3	
	18	JGG			
29.09	19	JGG	Cancelled		
	20	JGG			
01.10	21	JGG	Exercise		Pr. 2.16, 2.18 and 2.25

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Table 1 – continue

Date	Lecture	Responsible	Subject	Literature	Exercises
	22	JGG			
05.10	23	JGG	Exercise		Pr. 3.10, 3.16 and 3.17
	24	JGG			
06.10	25	JGG	Discrete Kalman Filter Basics	Ch. 3/4	
	26	JGG			
08.10	27	JGG	Exercise		
	28	JGG			
12.10	29	JGG	Exercise		Pr. 4 exam NTNU
	30	JGG			
13.10	31	JGG	Discrete Kalman Filter Basics	Ch. 4	
	32	JGG			
15.10	33	JGG	Exercise		Pr. 4.1, 4.2 and 4.3
	34	JGG			
19.10	35	JGG	Exercise		Pr. 4.4, 4.5 and 4.8
	36	JGG			
20.10	37	JGG	Complementary Filter	Ch. 8	
	38	JGG			
22.10	39	JGG	Exercise		Pr. 8.3
	40	JGG			
26.10	41	JGG		Exercise	
	42	JGG			
27.10	43	JGG	Complementary Filter	Ch. 8	

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Table 1 – continue

	Date	Lecture	Responsible	Subject	Literature	Exercises
c		44	JGG			
	29.10	45	JGG	Exercise		Pr. 8.4
		46	JGG			
	02.11	47	JGG	Exercise		Pr. 8.5
		48	JGG			
	03.11	49	JGG	Extended Kalman Filter	Ch. 7	
		50	JGG			
	05.11	51	JGG	Exercise		Pr. 7.1
		52	JGG			
	16.11	53	JGG	Exercise		Pr. 7.5
		54	JGG			
	17.11	55	JGG	Kalman Filter Applications	Ch. 9	Ex. 9.6
		56	JGG			
	19.11	57	JGG	Exercise		Pr. 9.1, 9.5
		58	JGG			
	23.11	59	JGG	Exercise		Pr. 9.6
		60	JGG			
	24.11	61	JGG	Kalman Filter Applications	Ch. 9	Ex. 9.8
		62	JGG			
	26.11	63	JGG	Exercise		Pr. 9.8
		64	JGG			
	30.11	65	JGG	Exercise		

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Table 1 – continue

Date	Lecture	Responsible	Subject	Literature	Exercises
	66	JGG			
01.12	67	JGG	Summary		
	68	JGG			
03.12	69	JGG	Exercise		
	70	JGG			