EMCH 792 Selected Topics in Mechanical Systems: Optimal State Estimation

1	Course Information

Course Description

Introduction to state-space dynamic systems and systems with noisy inputs. Theory and application of Kalman filters for state estimation, information fusion, multitarget tracking, and data association. Special focus on the discrete linear Kalman filter, the extended Kalman filter, and the unscented Kalman filter. MATLAB simulations will provide design experience and insight for intelligent control system design.

Contact hours – 3

2	Instructor Information

Dr. Nikolaos Vitzilaios
Email: vitzilaios@sc.edu
Phone: 8037779754
Office Location: 300 Main Street A219
Office Hours: In person or Online (MS Teams) by appointment

3	Textbook

Optimal State Estimation: Kalman, H∞, and Nonlinear Approaches
Dan Simon
Wiley, 2006, ISBN-10: 0-471-70858-5

4	Meeting Time/Location

Meeting Time, Location
Section 001: Tue-Thu 10:05am-11:20pm, Swearingen 2A07
Section J60: Tue-Thu 10:05am-11:20pm, Web

5	Course Topics

Topic	Simon Textbook	Est. weeks
1. Introduction to Kalman filters	Introduction	0.5
2. State-space dynamic systems	Chapter 1	1.5
3. Dynamic systems with noisy inputs	Chapters 2-4	2.0
4. The linear Kalman filter	Chapter 5	3.0
5. Kalman filter generalizations	Chapters 6-7, 9	2.0

6.	Nonlinear Kalman filters	Chapters 13-14	1.5
7.	Particle filters	Chapter 15	1.5
8.	Multitarget tracking	Chapter 10	1.5
9.	Simultaneous state and parameter estimation	-	1.5
10.	Kalman filter applications	-	0.5
A.	Linear algebra (matrix) review	Chapter 1	-

6	Course Outcomes

1. Students will explain basic concepts of states-space dynamic systems.
2. Students will study classical sensor fusion techniques such as Kalman filtering.
3. Students will implement Kalman filters in MATLAB.

7	Grading Policy

The final grade consists of grades from the following lecture and lab elements:

- Homework assignments: 75%
- Final Project\Exam: 25%

Guidance for letter grade assignment of the final grades are:

A≥90%, B+≥85%, B≥80%, C+≥75%, C≥70%, D+≥65%, D≥60%, F<60%

8	Attendance Policy

Attendance is required at all class sessions. If you are absent, you are responsible for learning the material covered in class. Students will be asked to report their seating location in the lecture room.

9	Workload

This is an aggressive course requiring homework assignments. Expect to spend six to nine hours per week outside of class reading the textbook and completing homework assignments. Some students will find that more time is required, while others will find that less time is required.

10	Homework Policy

Late submissions: homework grades will be capped at 60% for up to 24-hour late submission, a grade of 0 is assigned for more than 24-hour late submission. No late submissions will be accepted for the Final Project\Exam.

11	Miscellaneous Policies

Academic Integrity
University policies and procedures regarding academic integrity are defined in policy STAF 6.25, Academic Responsibility - The Honor Code (see http://www.sc.edu/policies/ppm/staf625.pdf). Prohibited behaviors

include plagiarism, cheating, falsification, and complicity. All potential Honor Code violations will be reported to the Office of Academic Integrity, which has the authority to implement non-academic penalties as described in STAF 6.25. Academic penalties for Honor Code violations in this course range from a zero on the assignment to failure of the course.

Diversity

In order to learn, we must be open to the views of people different than ourselves. In this time we share together over the semester, please honor the uniqueness of your fellow classmates and appreciate the opportunity we have to learn from one another. Please respect each others' opinions and refrain from personal attacks or demeaning comments of any kind. Finally, remember to keep confidential all issues of a personal or professional nature that are discussed in class.

Accommodating Disability

Reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, contact the Student Disability Resource Center: 777-6142 email sasds@mailbox.sc.edu, or stop by 1705 College Street, Close-Hipp, Suite 102, Columbia, SC 29208.
All accommodations must be approved through the Student Disability Resource Center.

Technical Support

Students facing issues with Blackboard or Microsoft Teams can submit requests on https://scprod.service-now.com/sp or call 803-777-1800.

Minimal student technical requirements/skills

All work in this course must be completed and submitted online. Therefore, students MUST have consistent and reliable access to a computer and the Internet. Students need to have their own laptop or desktop for running examples, exercises and project problems. Students need to have basic knowledge of MATLAB\Simulink.

Interactions

S2I: Blackboard announcements will be used with a combination of emails/teams for further interaction.

S2S: This is not required.

S2C: All course material is posted on Blackboard.

Online Learning Outcomes

All Learning Outcomes are equivalent of those of a face-to-face (F2F) version of the course.

Fair Policy

All readings/materials comply with copyright/fair use policies.

Technology

Course delivery will be conducted through Blackboard Ultra/Microsoft Teams.

12	Miscellaneous Information

Software

MATLAB software is required for this course. You can acquire and install MATLAB\Simulink on your personal computer using the UofSC educational license, check links below:

http://www.mathworks.com/academia/student_version/

https://scprod.service-now.com/sp?id=kb_article&sys_id=61da7c7cdbb4e300e1ff51f74b9619ea

MATLAB software is also available in the college computer labs.

Amendments to the Syllabus/Rules

Amendments and changes to the syllabus, including evaluation and grading mechanisms, are possible. The instructor must initiate any changes. The lecture schedule, reading assignments, and distributed learning activities may be altered at the instructor's discretion. Grading schema changes that unilaterally and equitably provide a mechanism to improve all students' grades may also be made at the instructor's discretion. Amendments to the syllabus will be distributed in writing or through Blackboard.