ECE5560

SYSTEM IDENTIFICATION

Spring 2019

Modern methods for identifying mathematical models of systems from observations of their behavior; input-output and state-space models; parameterization and identifiability; non-parametric methods; prediction and output error methods; recursive estimation; Kalman filters; order estimation; subspace identification. **Prer., MATH3400** *(differential equations),* **MATH3130** *(linear algebra),* **ECE2205** *(circuits I),* **ECE3610** *(probability and statistics), or equivalent.*

Instructor: Dr. Gregory Plett   **Office:** EN-290   **Phone:** 255-3468   **email:** gplett@uccs.edu
Course web-page: `http://mocha-java.uccs.edu/`

Office hours: TBD

Text: Ljung, L., "System Identification: Theory for the User," 2d, Prentice Hall PTR, 1999.
Text: van Overschee, P. and de Moor, B., "Subspace Identification for Linear Systems: Theory, Implementation, Applications," Springer (softcover reprint of the original 1st ed. 1996 edition), 2011.
Text: Ljung, L., "System Identification Toolbox 7: Getting Started Guide," (on course web server).
Text: Ljung, L., "System Identification Toolbox 7: Users Guide," (on course web server).

Optional software: The Matlab® Student Version, with System Identification Toolbox. All required MATLAB functions are available on the EAS CLaaS system, (see `http://www.uccs.edu/eas/claas.html`).

Evaluation: 1) Homework assignments/mini projects; 75 % total.
　　　　　　　　2) Final lab-data based project, 25 %.

Grading: 90–100=A^- to A; 80–89=B^- to B^+; 70–79=C^- to C^+;
　　　　　　60–69=D^- to D^+; 0–59=F.

Topics	Text	Est. Weeks
1. Introduction to system identification.	Ch. 1	0.5
2. LTI systems, time-domain nonparametric system ID.	Ch. 2, Ch. 6	1.5
3. Frequency-domain nonparametric system ID.	Ch. 2, Ch. 6	2.0
4. Transfer function models and parametric system ID.	Chs. 3, 4, 7, 16	3.0
5. Deterministic state-space models and system ID.	Notes,TK,JNJ,VODM	4.0
6. Stochastic state-space models and system ID.	Ch. 10, notes, VODM	3.0
7. Feedback and real-time system ID.	JNJ, Chs. 11, 17	1.0

Work Load: This is an aggressive course requiring weekly homework assignments. Expect to spend six to nine hours per week outside of class reading the textbook and completing homework assignments. This is in accord with UCCS policy relating credit hours for a lecture course to student workload. Some students will find that more time is required, while others will find that less time is required.

Homework Policy #1: Homework will be collected at the beginning of class on the assigned date. Homework turned in after the class period will be penalized 10%. Homework turned in after the due date will be penalized an additional 25% per day unless previous arrangements have been made with the instructor. Examinations will be based on the homework problems and the material covered in class. It is to your advantage to understand the fundamental concepts that are demonstrated in the homework problems. It will be difficult to earn higher than a "C" without performing well on the homework assignments.

Homework Policy #2: Your coursework (homework/project/exams) is expected to be a bona-fide individual effort. Copying homework, project or exam solutions from another student or other source is CHEATING and will not be tolerated. You may (and are encouraged to) discuss homework/project problems with other students, but only to the extent that you would discuss them with the instructor. Don't ask another student a question that you would not expect the instructor to answer. Most of us know when we are compromising our integrity. If you are in doubt, ask first.

Homework Policy #3: Part of your engineering education involves learning how to communicate technical information to others. Basic standards of neatness and clarity are essential to this process of communication. Your process of solving a problem must be presented in a logical sequence. Consider your assignments to represent your performance as an engineer. Do not submit scrap paper, and do not submit paper containing scratched out notes. Graphs are to be titled and axes are to be labeled (with correct units). The above standards of clarity and neatness also apply to your work on exams.

Attendance: Attendance is your responsibility. Class lectures will cover a significant amount of material. Some will not be in the text or may be explained differently. It is to your advantage to take notes, ask questions, and to fully participate in the classroom experience.

Missed Exams: Missed exams will count as ZERO without a physician's documentation of an illness, or other appropriate documentation of an emergency beyond your control and requiring your absence.

Drop Date: This course complies with the UCCS campus rules for drop date.

Homework Format Rules: Points will be deducted for failure to comply with the following rules:

1. Use 8 1/2 by 11 paper (engineering paper is good).
2. Write on one side of the paper only.
3. Enclose your final answer to each problem in a box so that it may be clearly identified.
4. Write name and date and homework set number in the right corner.
5. Staple in the upper left corner. Use only one staple!
6. Be sure to write in pencil. Do not use ink to complete your homework assignments.

The Course Reader: These notes have been entered using L$_Y$X, and typeset with LaTeX2$_\varepsilon$ on a Macintosh Core i7 computer running the OS X operating system. All diagrams (with the exception of a few scanned photos) have been created using either xfig or Matlab. Several sections in these notes have been adapted from lectures and lecture notes by Drs. Jonathan How and Stephen Boyd at Stanford University. Special thanks to Mr. Dante DePalma for his very hard work to develop some of the materials for this course.

The EduFile Course Supplement Managment System (EduFile):

The class homepage is accessed via `http://mocha-java.uccs.edu/`. Click on the [+] sign next to the course name, and then click on the link to access course supplements.

Follow this link, and you will be directed to the log-on screen:

Enter your student information for ECE5560 to download course supplements.

Student ID: [ ]

Password: [ ]

(Login) (Clear)

If you haven't used this system before, you will need to **register**.

The first time you use the system, click on the word "register". You will be directed to the screen:

Create Account

Fill out the form below and click "Create" to create your account. All fields are required.

First Name: [ ]

Last Name: [ ]

Student ID: [ ]

Password: [ ]

Confirm Password: [ ]

Phone: [ ]

E-mail Address: [ ]

(Create) (Reset)

Enter the requested information and press "Create". You should see the screen:

User Created

The user FirstName LastName (ID: 111223333) has been successfully created. A notification message has been sent to your professor to enable this account.

Note that passwords are case-sensitive!

You will not immediately gain access to course supplements. You will receive email notification when your account is enabled for this course. Only then may you log on using your student ID and password. You will see a screen like this (tailored to ECE5560, of course). Download at will!

Welcome to EduFile

Course Info	
Instructor Name:	Dr. Gregory Plett (**glp@eas.uccs.edu**)
Course Name:	System Identification
Course Description:	Modern methods for identifying mathematical models of systems from observations of their behavior; input-output and state-space models; parameterization and identifiability; non-parametric methods; prediction and output error methods; recursive estimation; Kalman filters; order estimation; subspace identification.

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