EEL 5250: Power System Detection and Estimation

Department of Electrical Engineering and Computer Science

College of Engineering and Computer Science, University of Central Florida

COURSE SYLLABUS

Instructor:	Dr. Junjian Qi	Term:	Fall 2018
Office:	R1 150E	Class Meeting Days:	
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I. University Course Catalog Description

Topics to include power system stability detection, line outage detection, static and dynamic state estimation, parameter calibration and model validation, and cybersecurity.

II. Course Overview

This is an advanced course to power engineering, designed to provide students with the knowledge of data-driven stability and outage detection and state estimation methods, especially those based on synchrophasor measurements. Course content includes basics of synchrophasor, voltage stability detection, angle stability detection, oscillation detection, line outage detection, static and dynamic state estimation, parameter calibration and model validation, and cybersecurity issues related to synchrophasor data.

III. Learning Outcomes

By the end of this course, **undergraduate** students will be able to:

- Describe basic concepts of the synchrophasor technology.
- Acquire knowledge of data-driven detection and estimation methods in power system operation and control.
- Develop skills to communicate effectively through writing and presentation.

In addition, **graduate** students will be able to:

- Develop the ability to apply knowledge of data-driven detection and estimation methods to solve problems in power system operation and control.
- Describe in a report, and build a math model (e.g. MATLAB) of a synchrophasor measurement based method to improve the situational awareness or the stability of a power system.

IV. Course Prerequisites

Course Prerequisites: EEL4216-Fundamentals of Electric Power Systems. Familiar with power system analysis methods at the level of standard text books, including the ones by Bergen & Vittal, Grainger &

Stevenson, and Glover & Sarma. Familiar with the topics of matrix algebra, calculus, network analysis theory including electric power flow analysis, and basic optimization concepts.

V. Course Credits

3 credit hours

VI. Required Texts and Materials

[1] P. W. Sauer, M. A. Pai, and J. H. Chow, *Power System Dynamics and Stability: With Synchrophasor Measurement and Power System Toolbox*, Wiley, 2018.

VII. Supplementary (Optional) Texts and Materials

[2] A. G. Phadke and J. S. Thorp, *Synchronized Phasor Measurements and Their Applications*, 2nd Edition, Springer, 2017.

[3] A. Abur, A. G. Expósito, *Power System State Estimation: Theory and Implementation*, CRC press, 2004.

[4] P. M. Anderson, A. A. Fouad, *Power System Control and Stability*, 2nd Edition, Wiley-IEEE Press, 2002.

VIII. Topics

- Basics of synchrophasor
- Voltage stability detection
- Angle stability detection
- Oscillation analysis and detection
- Line outage detection
- Static and dynamic state estimation
- Observability and synchrophasor placement
- Robust state estimation
- Parameter calibration and model validation
- Protection systems with phasor inputs
- Cybersecurity issues related to synchrophasor data

IX. Course Evaluation

Project

At the beginning of the class, each student picks his/her own topic, and students are expected to conduct in-depth research on that topic throughout the semester, including literature review, algorithm design, implementation and case studies. Students are required to submit a midterm and a final written report.

Presentations

Students are required to give one topic presentation and one project presentation in the class. Each presentation will last for 20 or 30 minutes, depending on the actual enrollment of the class. The topic presentation serves as a summary of the literature review. It should cover background on the selected topics and a review of one selected method or algorithm that you think innovative and creative. The project presentation will be held at the end of the course, and it should cover details of your research journey (literature review, your methodology, implementation and case studies).

Percent of Final Grade

- Homework: 25%
- Topic Presentation: 15%
- Project Presentation: 15%

- Midterm Project Report: 20%
- Final Project Report: 25%

Grading Scale

- A: 90-100
- A-: 87-90
- B+: 83-87
- B: 80-83
- B-: 77-80
- C+: 73-77
- C: 70-73
- D: 60-70
- F: 0-60

X. Course Policies

Financial Aid Requirement: All instructors/faculty are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please complete the following academic activity by the end of the first week of classes or as soon as possible after adding the course. Failure to do so may result in a delay in the disbursement of your financial aid.

Late homework will not be accepted.

Report format: Competition and project report submission should follow IEEE journal format.

Plagiarism: It is not allowed and will be heavily penalized based on UCF student policies.

Email: It is the student's responsibility to check email often. When emailing instructor, in the email subject line, type: EEL5250 + additional, yet concise, useful/revealing info. Provide sufficient detail in the text message.

Attendance: You are highly encouraged to participate in discussion during the class. Although there is no attendance check, you are expected to show up every class. It is imperative that you come to class and take notes.

Disability Access: The University of Central Florida is committed to providing reasonable accommodations for all persons with disabilities. This syllabus is available in alternate formats upon request. Students who need accommodations must be registered with Student Disability Services, Ferrell Commons Room 185, phone (407) 823-2371, TTY/TDD only phone (407) 823-2116, before requesting accommodations from the professor.

Professionalism Policy: Per university policy and classroom etiquette; mobile phones, iPods, *etc*. must be silenced during all classroom and lab lectures. Those not heeding this rule will be asked to leave the classroom/lab immediately so as to not disrupt the learning environment. Please arrive on time for all class meetings. Students who habitually disturb the class by talking, arriving late, *etc*., and have been warned may suffer a reduction in their final class grade.