ESE 576 Power System Dynamics

Syllabus

The course provides the background for understanding power system dynamics and numerical simulation techniques. Topics include the numerical integration for large scale power networks, numerical oscillation and its solution, power system component modeling, frequency-dependent transmission network, nonlinear elements, network equivalents, power network stability, simulation of power electronic inverters, and microgrid stability & control. The area of real-time simulation for cyber-physical power infrastructures will also be discussed.

Instructor

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Office hours: Thursday 3pm - 5 pm, Friday 11am - 12pm

Prerequisite

None.

Location and Time

TBD
Monday 6:05-8:55 pm

Outline

Topic 1: Time domain solution of power system dynamics (1 week)

Topic 2: Wave propagation in power lines (1 week)

Topic 3: Accurate modeling of frequency-dependent power line (1 weeks)

Topic 4: Numerical discretization techniques (1 week)

Topic 5: Rotating machines dynamics (1 week)

Topic 6: Large power system solutions (1 week)

Topic 7: Power electronic devices and systems (2 weeks)

Topic 8: Hardware-in-the-loop simulation of power system dynamics (1 weeks)

Topic 9: Microgrid dynamics simulations (2 weeks)

Topic 10: Emerging topics (1 week)

Learning Outcomes

By the time the course is completed, students will have acquired knowledge and skills with power system dynamics which include the ability to:

* Understand power system dynamics and its differences from power system steady-state behaviors;
* Use RTDS for real-time simulation of power system dynamics;
* Develop programming capabilities by writing their own computer programs to solve power system dynamic problems;
* Understand the principles, capabilities, limitations, and future trend of power system dynamics analysis tools.

Course Notes

Lecture notes are developed by Prof. Zhang. All course materials will be available online.

References

[1] H. W. Dommel, *EMTP Theory Book*. Microtran Power System Analysis Corporation, 1996.

[2] P. Zhang, *Networked Microgrids*. Cambridge University Press, 2020.

[3] J. A. Martinez-Velasco, *Transient Analysis of Power Systems: Solution Techniques, Tools and Applications*. John Wiley & Sons, 2014.

[4] N. Watson and J. Arrillaga, *Power Systems Electromagnetic Transients Simulation, Second Edition*. IET, 2019.

[5] P. W. Sauer, M. A. Pai, and J. H. Chow, *Power System Dynamics and Stability*. John Wiley & Sons, 2017.

[6] F. M. Uriarte, *Multicore Simulation of Power System Transients*. IET, 2013.

Experimental and Computing Tools

RSCAD (RTDS NovaCor), Matlab/Simulink, PSCAD/EMTDC

Evaluation Scheme

Homework Assignments: 60% or 70%
Term Project: 40% or 30%

Grading Scale

Score	Grade	Score	Grade
≥90	A	70-74	B−
85-89	A−	65-69	C
80-84	B+	60-64	D
75-79	B	<60	F

Policy

1. Even though discussion and study groups are encouraged, students are not allowed to copy answers or procedures in homework assignments or should not allow their answers or procedures to be copied.

2. Late homework is not accepted unless extenuating circumstances are present.

3. Projects can be done individually or by teams of two or three. If the homework is done by a team, both students need to submit the report and source files individually but the teamwork should be declared in the report. Projects done individually will receive a 5% bonus.