EEL 6291 Smart Grid

Credits: 3 credits

Textbook, title, author, and year: The followings will be posted on Canvas, which are required for reading.

- Lectures Slides
- Linear Algebra Review and Reference
- A Practical Introduction to MATLAB
- Appendix -Electric Power System Basics
- Related Research Papers

Reference materials:

Taken together, these textbooks cover most of the material we cover in this class. This list is strictly optional reading for those who might want to pursue one of the topics more deeply; the lecture slides themselves cover everything that will be needed for the homework, and these books together cover substantially more material than what we cover in class.

- Machine Learning: C. Bishop. *Pattern Recognition and Machine Learning*.
- Optimization: S. Boyd, L. Vandenberghe. *Convex Optimization*.
- Electrical Power Systems: A. von Meier. *Electric Power Systems: A Conceptual Introduction*.
- Model Predictive Control: E. F. Camacho and C. Bordons. *Model Predictive Control*.
- Particle Swarm Optimization: James F. Kennedy. *Swarm Intelligence*.

Smart Grid Security: S. Goel, Y. Hong, V. Papakonstantinou, and D. Kloza. *Smart Grid Security*

Specific course information

Catalog description:

This course is intended for a broad audience: students who wants to know energy systems/smart grid and develop a better understanding of computational techniques that can be brought to bear on these problems, or students who may have a strong background in CS but who want to explore applications in energy systems (or even those who want to learn both). This course will also introduce graduate students to the start-of-the-art of cyber-physical security in smart grids, networked controls, and safety-critical cyber-physical systems (CPSs). The course will cover concepts, theories, methods, and latest topics in this strategic area with growing research interests and industrial demands. Students will acquire an in-depth knowledge in smart grids while expose to principles and practices in data analytical, optimization, control, and power systems. The course will also prepare the students for research and engineering that apply to not only smart grids but also smart cities, Internet-of-Things (IoTs), and other modern intelligent systems.

Prerequisites:

Graduate Standing or permission from instructor

Specific goals for the course:

The goal of this course is to provide students with a broad background in state-of-the-art computational methods that repeatedly arise in smart grid, such as machine learning, optimization, and control, and to provide hands-on experience applying these methods to real-world domains. In particular, much of the class will use real data from electrical grid as a running example, and address issues regarding the prediction, modeling, and control of electricity from existing and renewable energy sources

Brief list of topics to be covered:

This course will cover the fundamental of computational intelligence and the applications in smart grid. The computational techniques include:

- regression and classification
- time series prediction
- Newton's method for non-linear equations
- convex optimization
- networked control
- model predictive control
- swarm intelligence
- etc.

And the application areas include:

- cyber-physical smart grid
- electricity demand and renewable resource prediction
- modeling energy consumption in buildings
- electrical power systems, power flow, and power markets
- control of distributed storage
- etc.