ME 597: Distributed Energy Resources – Spring 2024

Tuesdays and Thursdays from 3 to 4:15 PM ET in Physics 201 and on Zoom
Instructor: Kevin J. Kircher, kevinjkircher.com

Image credit: DOE Loan Programs Office

Distributed energy resources (DERs) are controllable electrical devices that plug in at the edge of the power grid, typically through buildings. DERs – such as electric vehicles, heating and cooling equipment, energy storage systems, and rooftop solar photovoltaics – will play an increasingly important role in future energy systems that decarbonize, digitalize, and decentralize their operations. In this class, students will learn to model a variety of DERs, optimize DER designs, and control DERs to reduce costs, pollutant emissions, and impacts on the power grid. This class will involve a mix of coding and mathematical analysis. Students will do semester projects on current DER research and development topics.

Format: In-person and online

Grading: 20% homework, 30% take-home exam, 50% final project

- Homework, the exam, and final projects will involve some mathematical analysis and a lot of coding.
- Code can be written in Matlab, Python, or Julia, but the course staff will only support Matlab.
- I encourage students to work together on homework, but each student must submit their own solutions.
- The TA(s) will grade homework quickly on a three-tier scale (full, half, or zero credit) based on how much of the solution is present, clear, and correct.
- Each student will individually take a 24-hour take-home exam about halfway through the semester.
- Students can do projects individually or in teams of two to five.

- Each team will submit one final project report, written in LaTeX in a conference paper format.
- Each team will give one final project presentation, formatted like a conference talk.
- Only one student from each team should present, but the whole team should help them prepare.
- Teams of online students may pre-record video presentations or present during class via Zoom.
- Each student will assess their contributions to their project in a final meeting with me and their team.

Tentative schedule: 15 weeks, ~30 classes, 75 minutes per class

- Introduction to energy systems and DERs (1 class)
- Modeling and simulating DERs (~6 classes)
- Optimization (~4 classes)
- Control (~7 classes)
- Applications (~8 classes)
- Project presentations (~4 classes)

Prerequisites

- Required: Linear algebra, ordinary differential equations, and facility with programming in a language such as Matlab, Python, or Julia.
- Not required, but may enhance appreciation: Probability, statistics, control systems, optimization, machine learning.

Textbook: None

I'll post lecture slides, videos, and sample code online.