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EE491 Performance of Power Systems

Course Overview
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Power Systems

To generate, to transmit, and to distribute electric **power** to consumers, meeting the demand always, while maintaining strict tolerances on voltage magnitude and frequency, in a safe, secure, resilient, and economical fashion.

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Generation

- Fossil fuel plants
 - Coal, Natural gas
- Nuclear plants
- Hydro plants
- Renewables
 - Wind, Solar

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Transmission

- High Voltage AC Transmission
- High Voltage DC Transmission

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Distribution

- Smart distribution feeders
- Substation automation
- Microgrids

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Loads

- Industrial loads
- Commercial loads
- Residential loads

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Operational Requirements

- Acceptability/Viability
- Small-signal stability
- Large disturbance stability
- Optimality/Economy

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Acceptability or Viability

- All line currents and all bus voltages stay within tolerances
- Usually loads and generations specified in terms of power quantities
- How to calculate bus voltages and line currents?
- Power-flow problem

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Stability

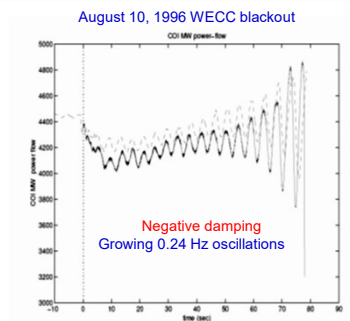
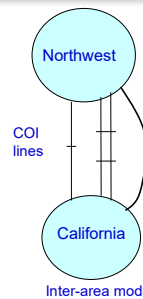
- Operation must be able to withstand disturbances
- Disturbances can be small or large
- Small-signal stability
 - Well-damped oscillations
 - Linear models
- Transient stability
 - Recover from large disturbances such as faults
 - Nonlinear models

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Small-signal instability in WECC



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Optimality

- Minimize costs
- Economic dispatch problem
 - Generation scheduling
- Optimization

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Other Topics

- State Estimation
 - How to estimate state of the power grid from noisy measurements?
 - Least square fit
- Automatic Generation Control (AGC)
 - Load frequency control
 - SCADA, EMS
 - Wide-area control

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