**Smart Contingency Analysis**

Objectives:

* Advanced topology handling seamlessly support node-breaker or bus-branch models
* Use cross sensitivities across scenario and time dimensions
* Exploits versioning DB capabilities

Voltage and Angle Sensitivities (Lecture 8, ECE 6320):

* Need very fast methods for security analysis in real-time
* Exploit linear techniques
* Sensitivities defined for DC power flow (disregard reactive power, voltage levels, and active power losses)
  + PTDF: measures sensitivity of line power flow to a change in bus generation
  + LODF: measures sensitivity of line power flow to an outaged line
  + TLR: measures
  + OTDF:

Traditional Contingency Analysis (Lecture 9, ECE 6320):

* First need a base (normal operation/present state) case
  + May have different base cases for different seasons, times of day, etc.
* Then solve the power flow
* Monitor the following:
  + Max and min per-unit voltage magnitude
  + Line/transformer limits in MW/MVA/A
  + Interface MW limits
* Contingency actions
  + Open/close line/transformer
  + Loss/recovery of generator/load/switched shunt
  + Move generator/load/injection group/switched shunt MW/MVAR
  + Change or set generation/load/injection group/switched shunt MW/MVAR
* DC PF solution method

**obtain** an AC or DC single solution for base case

**compute** PTDFs, LODFs

**for** each contingency **do**

**compute** post contingency flows

**report** limit violations

**end**

* System metrics
  + Aggregate Percentage Contingency Overload (APCO)
  + Aggregate MW Contingency Overload (AMWCO)
  + SysAMWCO
  + Thermal Security Index (TSI)
* Remedial Actions Schemes (RAS)
  + Line limit violations
    - Re-dispatch generation to mitigate overload (using TLR)
    - Move additional active power control (phase shifters, DC lines)
    - Move scheduled interchange
    - Load shedding
* Voltage limit violations
  + - Modify generation set point values
    - Connect/disconnect capacitors and reactors

**Cross sensitivities across scenario and time dimensions**

* Look at node-breaker model and distribution factors
* Linear sensitivity analysis
  + Sensitivities such as the variation of MW flow w.r.t. a change in generator MW output are rather linear
  + Value represented by a sensitivity analysis is only good for small adjustments and must be recalculated often

Consider two scenarios:

1. Change in one generator’s generation profile

Similar to transmission line relief.

PTDFs show how to calculate the impact of one transfer on all transmission lines. TLR or GSF (generation shift factors) calculate the impact of all transfers on one transmission line. (GSF always involve a transfer with the slack bus being the buyer.)

1. Addition of a candidate new line

Similar to if a line is disconnected initially, but then is switched to be closed (line closure distribution factor).

