Reinventing Transmission and Resource Planning

Breakthrough Engineering Technology In Power System Analysis

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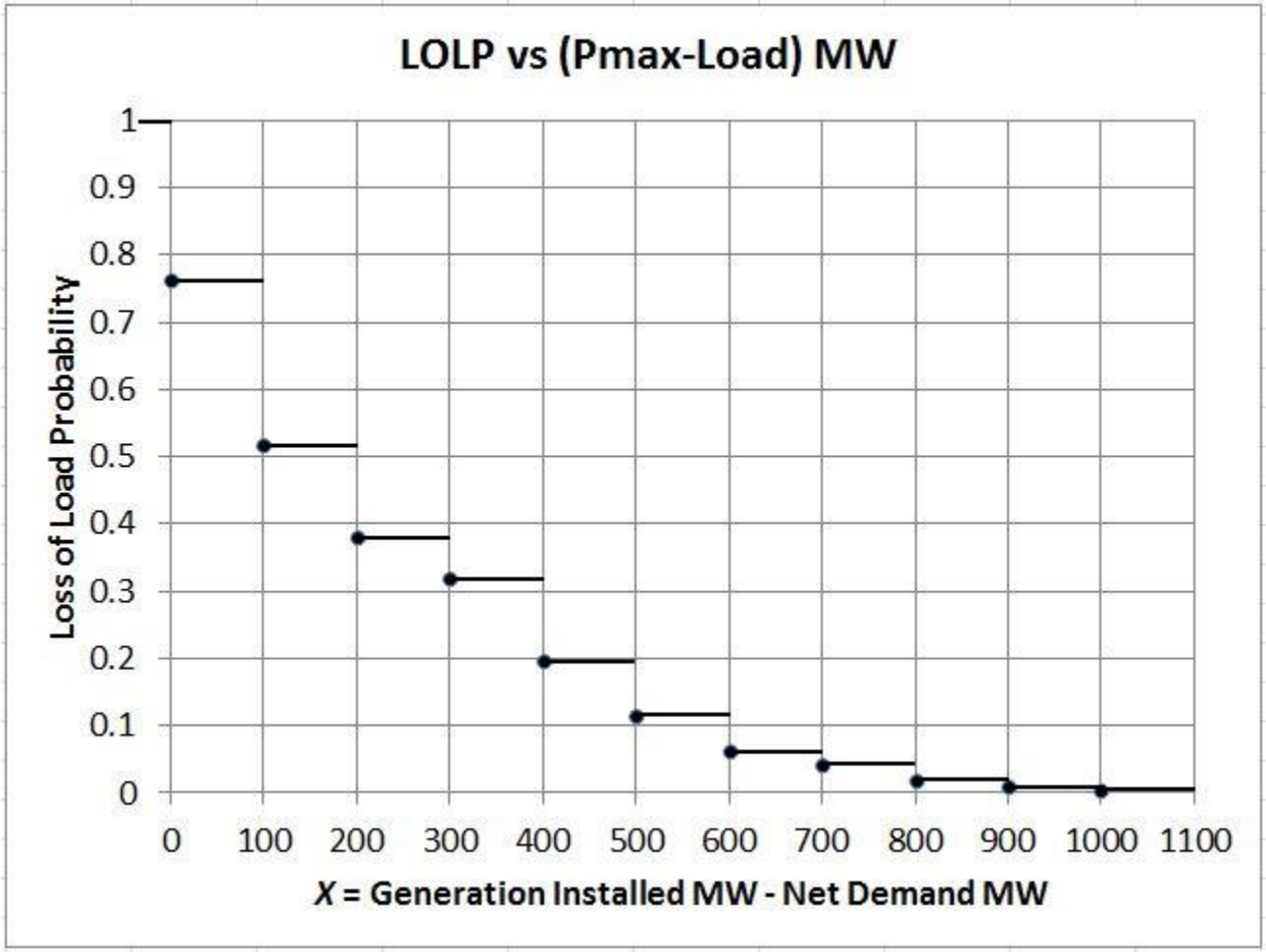
- Execution speeds millions of times faster than Monte Carlo
- Models variable energy sources using only the actual raw data
- Six digit ‘exact’ reliability indices independent of network size
- Transmission constraints are handled probabilistically in RTS2
- Automatically finds the peak demand MW for a target LOLE

Key Ideas:

- Production costing and CO_2 reduction is a study of the maximum production of variable energy resources.
- Reliability adequacy is a study of installed equipment capacity and the minimum production of variable energy resources.
- The first step in planning a system is to make it reliable, and then the second step is to calculate the overall plan's cost.
- Transmission lines connecting an area to the larger grid look just like a type of power plant that serves the local area.
- Convert reliability indices to an equivalent maximum demand, i.e. build in a demand seeking routine to convert LOLE into a maximum load level that can be served reliably - for the public

Create a COPT ‘exact’ Capacity Outage Probability Table:



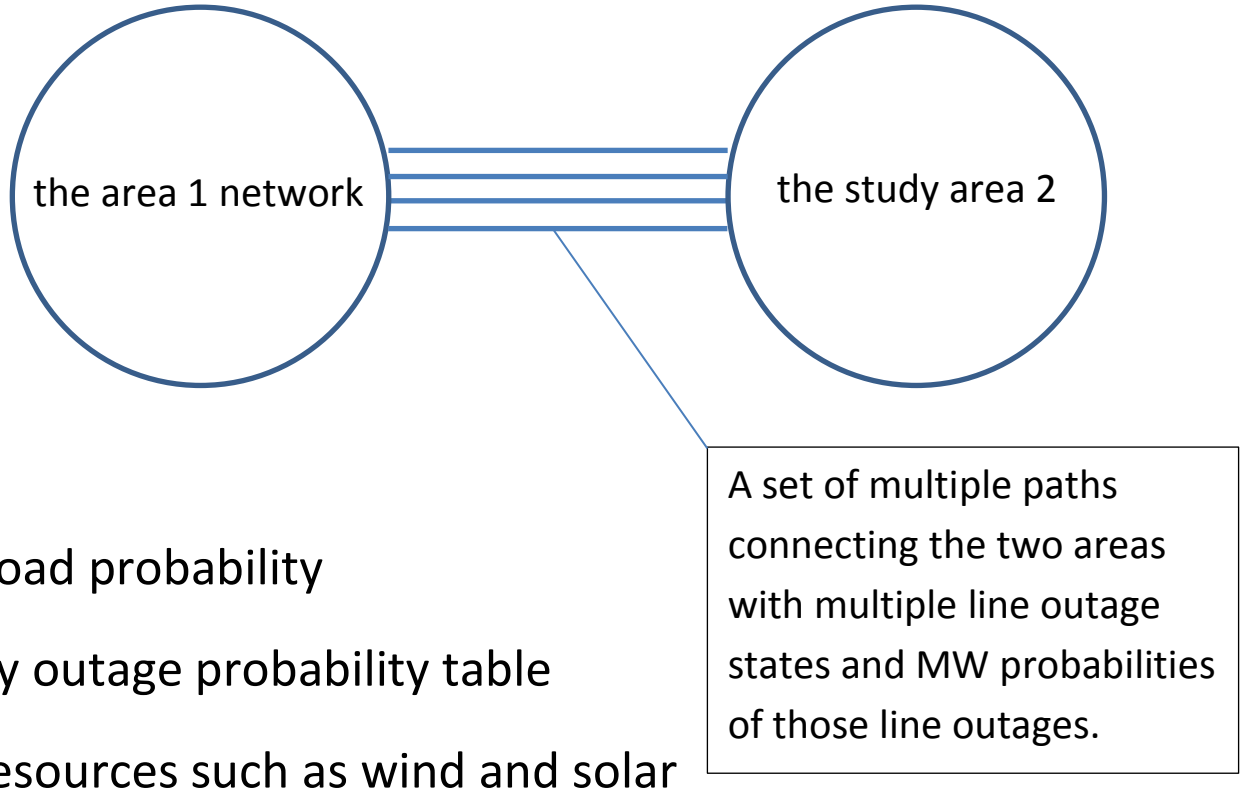
Hourly LOLP is a simple ‘lookup’ in the table. (use 1 MW steps)

COPT used in the RTS evolution history:

- Baleriaux in France in late 1960s created an approximation
- Booth in Australia in 1972 proves it's an 'exact' calculation
- Preston in 1997 uses a binary tree to prove 'exactness'
- Billington in 1986 publishes 'exact' indices for the RTS
- IEEE in 2016 asks Gene if he can add wind to the RTS model
- Gene says he will if he can duplicate the 1986 paper results
- He does and finds the COPT is extremely fast and accurate
- Every hour lookup the LOLP of the demand – (wind+solar) MW
- LOLE is the sum of daily maximum LOLPs (same LOLE in MC)
- LOLH is the sum of hourly LOLPs (exactly same LOLH using MC)
- Include a 7 step normal distribution Load Forecast Uncertainty

Two Area LOLP Hourly Load, Variable Resource, and COPT in RTS2:

In RTS2 the probabilistic model interpretation shows area 2 can view the transmission lines bringing power into area 2 as an equivalent generator.



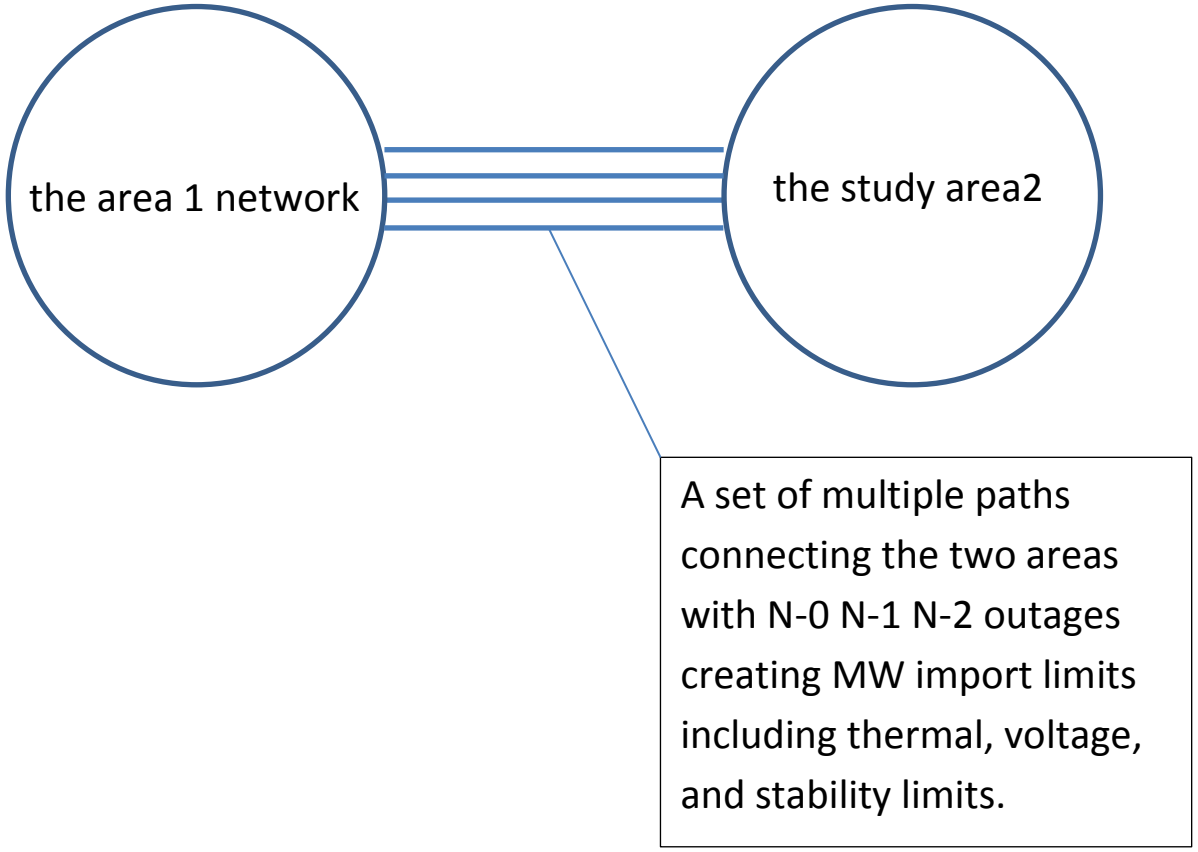
LOLP = loss of load probability

COPT = capacity outage probability table

VR = variable resources such as wind and solar

Note that area 1 includes everything in area 2 in the area 1 data.

An Available Transfer Capability (ATC) detailed electrical analysis can be used to find all the significant transmission constraints:



We take advantage of the reliability and electrical model's similarities.

Two Area RTS2 Input Data Requirements:

- Gdata file generator data (MW's, FOR's) for conventional power plants for the larger grid, such as ERCOT.
- Hdata file hourly historical demand and variable energy resources such as wind and solar in different locations.
- Run the above files through RTS1 to get single area indices.
- Gdata file generator data (MW's, FOR's) for conventional power plants inside the study area, such as Austin Energy.
- Hdata file hourly historical demand and variable energy resources such as solar power inside the study area.
- An extra line in the Gdata study area file describes the transmission tie lines importing power limits and probabilities.
- RTS2 calculates a maximum peak demand that can be served.