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Jacob Lehmer

Computerized Wind Farm Generation Tie Line Infrastructure Footprint Routing and Subsequent Dynamic Line Rating

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Idaho National Laboratory

Introduction

- Electrical Grid
  - Generation
  - Transmission
  - Distribution
- Modern Trends
  - Renewable Integration
  - Power Dispatching
  - Smart Grid Technologies

Transmission Route Engineering and Design

- Planning
  - Initial determination
  - Development of alternate routes
  - Public Opinion
  - Prefer a route
- Line Design
- Public Opinion
- Legal Battles
- Tower Construction

Path Finding Algorithm

- Dijkstra's Algorithm
  - Discrete Mathematical Graph Traversal
- A* Algorithm
  - Dijkstra's Algorithm
  - Create the discrete graph as the application runs from cartesian grid
    - Valuation of terrain data
  - Require system bounding and rectangular grid featuring system
- TREAD Algorithm
  - Grid system defined radially, optimizes to straight line segments

Cartographic Data

- Geographic 2d representation
  - Shape Files
    - Polygonal Data
    - Line Data
      - Right of way around the line generated
  - KML Files
- 3d Data
  - GWS
- Public Opinion
- Weather Data
  - Forecasted
  - Historical

Terrain Data

- Graphical data has some effect on line construction
- Determining a reasonable value to adjust routing is a considerable issue
- Common sense routing effects can be quite reliable
  - Slopes are more difficult to construct on

Utility Integration

- Utility usage of transmission lines rely on ratings and usage planning
- Ratings are developed through static line rating calculation methods
- Generalized Line Ampacity State Solver Allows for rating transmission lines dynamically with hypothetical route
- Build possible routes from the planned wind generation capability and the location to the tie line as a basis

Not In My Backyard

The Court Of Public Opinion

- All transmission routes travel across different political areas
- Some landowners do not want to have a transmission line built on their owned land
- Tread allows for these landowners to have their land marked as a no build zone
- Rapid re-development could be made that will allow for people to have their voices heard

Dynamic Line Rating

- Dynamic Line Rating (DLR) is the process of using real time conditions to change the allowed capacity of the line
- DLR can be performed in several different ways
  - On Line Sensors
  - Environmental Monitoring
  - Computational Fluid Dynamics
  - Historical Analysis
    - Requires sufficient data
  - Forecasted Data

Wind Generation and DLR Synergy

- Dynamically adjusting a transmission line requires a change in environmental conditions that allow for higher capacity
  - Reduction in temperature
  - Increase in wind speed
- Wind generation increases in generated capacity when there is an increase in wind speed

- Dynamic Line Rating can reduce curtailment of a wind plant
  - Increase in generation is matched with an increase in capacity

- TREAD can use forecasted data as well as computational fluid dynamics to maximize the dynamic line rating of a possible transmission route