Wide-Area Electric Grid Visualization Using Pseudo-Geographic Mosaic Displays

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Motivation

• Maintain situational awareness by presenting system data in an informative way for system engineers and operators
  • Preserve relative geographic relationships
  • Use display space effectively
Visualization Practices

• Geographic representation of entire grid
  • Branch flows
  • Contour Maps

• However, these present challenges
  • Areas of interest may compose a small geographic footprint
  • Visualization dense with information

Synthetic Grid test cases publicly available at: https://electricgrids.engr.tamu.edu/electric-grid-test-cases/
Geographic Data Views

• Automatically update geographic display with system values of interest

Label: System Area
Size: MW Generation
Color: MW Export
Pseudo-Geographic Mosaic Displays

- Maintains approximate geographic relationships using more display space

Can be used to convey:
- Element status
- System operating conditions

Can aid:
- Situational awareness
- Data interpretation
- Quick comparisons across studies
PGMD Layout Algorithm

• Basis similar to treemap algorithm
  • Nested rectangles used to visualize tree structure

• Mosaic Displays based on this layout set to have uniform column width
  • Width is set to depend on the sum of size metrics of the tiles represented
  • Height dependent on size metrics relative to other column elements

• Alternate layout approach options to come!
2,000 Bus Switched Shunt Visuals

**Label:** Shunt Name
**Size:** Shunt Nominal MVAr

**Fill Color:**
Shunt Regulation Voltage Error

**Outline Color:**
Switched Shunt Status

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**GDV**

**PGMD**
2000 Bus Case – Generator PGMD
Design Considerations

• **Who** is your audience and **why** will they be using the displays?
  - “Snapshot” of grid
  - Long-term users

• **How** to depict data?
  - Tile sizing
  - Tile placement
  - Colors

• **What** to depict?
  - Substations
  - Generators
  - Loads
  - Shunts
  - Lines
  - ...
Generator Size and Type

Label: Generator Bus Number
Size: Max MW
Color: Fuel Type
- Magenta = Nuclear
- Gray = Coal
- Orange = Natural Gas
- Blue = Hydro
- Green = Wind
- Yellow = Solar

Note that overlapping tiles make it difficult to discern fuel mix in urban areas.
Horizontal Packing Comparison, 50%

Same information, different impression.
PGMD Opportunities

• Quick visual comparison across studies with changing system conditions
• Dynamic visualization loops
• Display multiple attributes or system parameters
• Various layout algorithms
Questions?

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