Secure the Electrical Power Grid: Smart Grid versus Smart Attacks

Smart Grid Security

- Core of future energy infrastructure
- Key to critical & strategical sectors
- Exposed to cyber-physical attacks

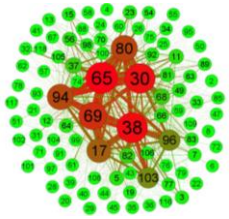
Challenges

- Massive blackout vulnerability
- Emerging cyber-attack risks
- Legacy and unregulated systems

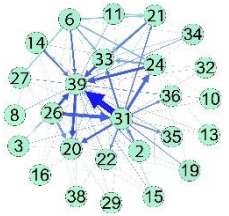
Technical Activities

Category	Investigations Conducted		
Targets	Substations	Lines	Joint
Schemes	Concurrent	LDV, RG, CIG	
	Sequential	SAG, Q-Attack	
Models	Topological	Complex Networks	Power Flow
Metrics	Netability	Extended Betwenness	Critical Moments
Solutions	Attack Risk Visualizers	Learning-Based Detectors	Self-Adaptive Controllers

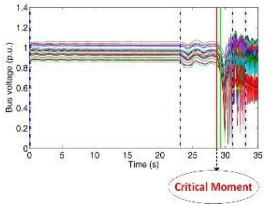
Significant Outcomes



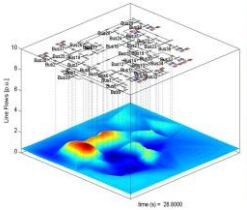
Risk Graph enables fast vulnerability analysis



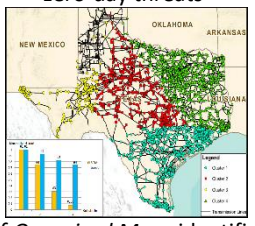
Sequential Attack reveals zero-day threats



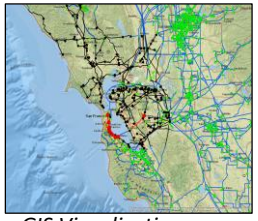
Critical Moment indicates system collapse



Steady-State Model simulates cascading failures



Self-Organized Maps identifies critical components



ArcGIS Visualization supports intuitive blackout analysis

Scientific Impact

- Complex behaviors and interdependence
- Coordinated attack schemes and impacts
- Intelligent detection, control, and optimization

Broader Impact

- Secure and resilient energy infrastructure
- 5 courses, 4 PhD students, 7 summer interns
- 26 journal, 1 survey, 2 best paper awards

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