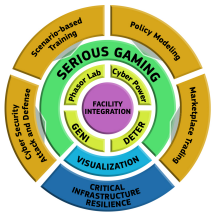
SMART AMERICA

SMART ENERGY CPS



The Nation's energy infrastructure is a complex cyber physical system (CPS) that forms the lifeline of modern society, and its reliable and secure operation is of paramount importance to national security and economic well-being. Our energy infrastructures are aging and highly vulnerable to natural events (e.g. hurricanes, earthquakes, etc.) and to man-made malicious events such as sophisticated cyber attacks. A critical need is the significant undertaking of fundamental and applied research that can transform our legacy infrastructures into smart ones that are resilient against extreme events, secure against cyber attacks, efficient in performance, and sustainable.

RESEARCH CHALLENGES:

- **Efficient Smart Energy Designs**
  - Methodologies for "co-design" of information, communication, and controls for wide-area monitoring, protection, and control of power grids.
  - Standards and technologies for time synchronized CPS networks.
  - Development of distributed and parallel algorithms for grid monitoring and control.
- **Resiliency and Cybersecurity**
  - Fundamental architectural paradigms and technology building blocks transforming "fault-resilient grid of today into an attack-resilient grid of the future".
  - Pragmatic risk modeling and mitigation framework capturing cyber-physical interdependencies and the dynamic nature of cyber threats and uncertainty using game-theoretic and behavioral models.
  - Understanding sophisticated coordinated attacks, cascading failures, and developing robust defensive technologies to achieve security, privacy, and resiliency.
- **Federated CPS Infrastructures and Testbeds**
  - Development of a national-scale high-fidelity, federated CPS testbed with remote access capabilities, to accelerate the pace of innovation and R&D.
  - Experimentation methods for the design and analysis of multi-resolution wide area control experiments for coherent simulation at appropriate time scales.
  - CPS Cloud architecture, algorithms, and services for resource provisioning, allocation, and control across federated facilities for large-scale, high-fidelity experimentation requirements.
  - A open and shared experimentation infrastructure for cross cutting CPS sectors (e.g. gas and oil and power and energy).
  - Serious games to explore the resiliency control and economic incentives in wide area control.

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