Research on Power Grid Resilience

Emmanouil Anagnostou

Center Director

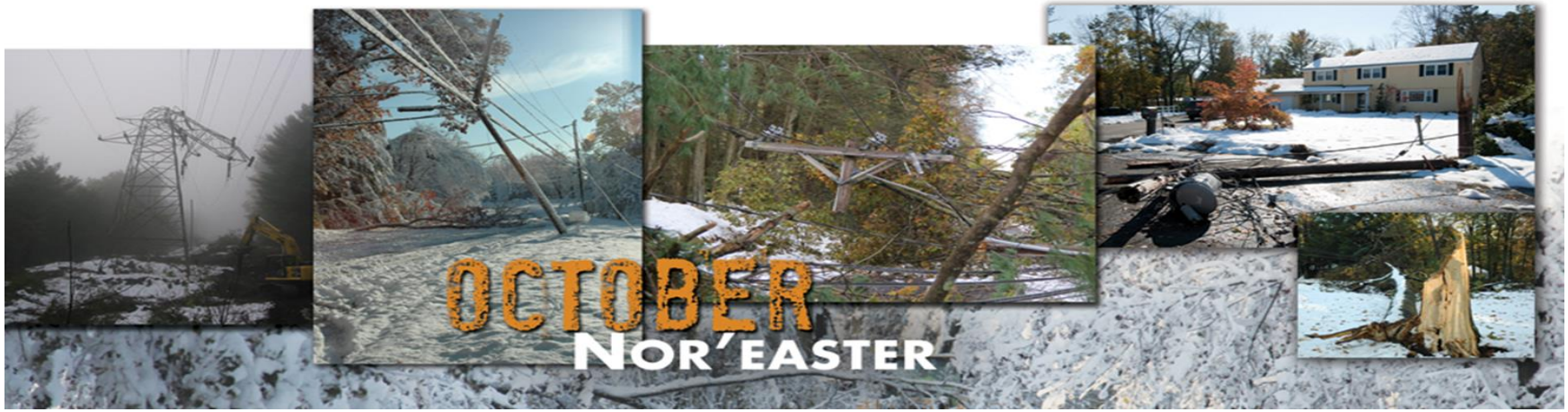
Board of Trustees Distinguished Professor

Endowed Chair in Environmental Engineering

06/04/2019 – NECPUC Symposium

2011 & 2012 Storms Revealed Information Gaps in Decision Making

Irene ($20B), October Nor'easter ($3B), Sandy ($62B)



2011 & 2012 Storms Revealed Information Gaps in Decision Making

From utilities' response to these storms it became evident that managers' intuition was not the best way to predict outages: Connecticut's Governor Malloy formed the ***Two Storm Panel***.

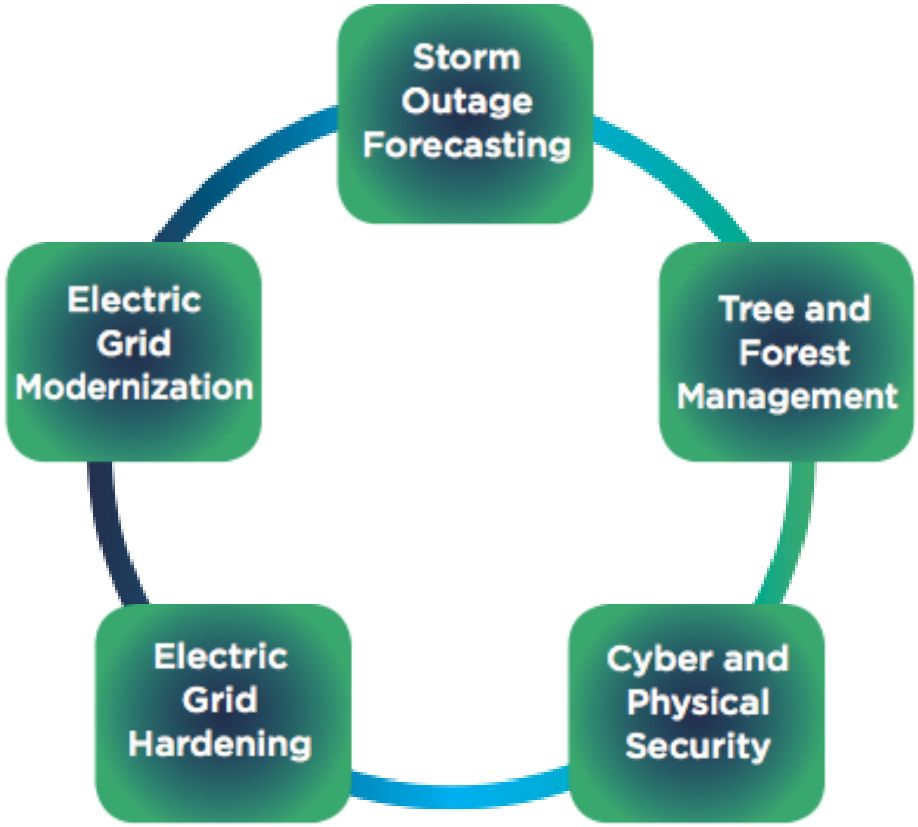
The panel recommended to build a collaboration between the State, utilities and a university to develop a ***hazard assessment capability that can identify "hot spots" for storm damage and integrate early warning with preparedness and emergency management.***

(McGee et al., 2012)

Eversource Energy Center at UConn

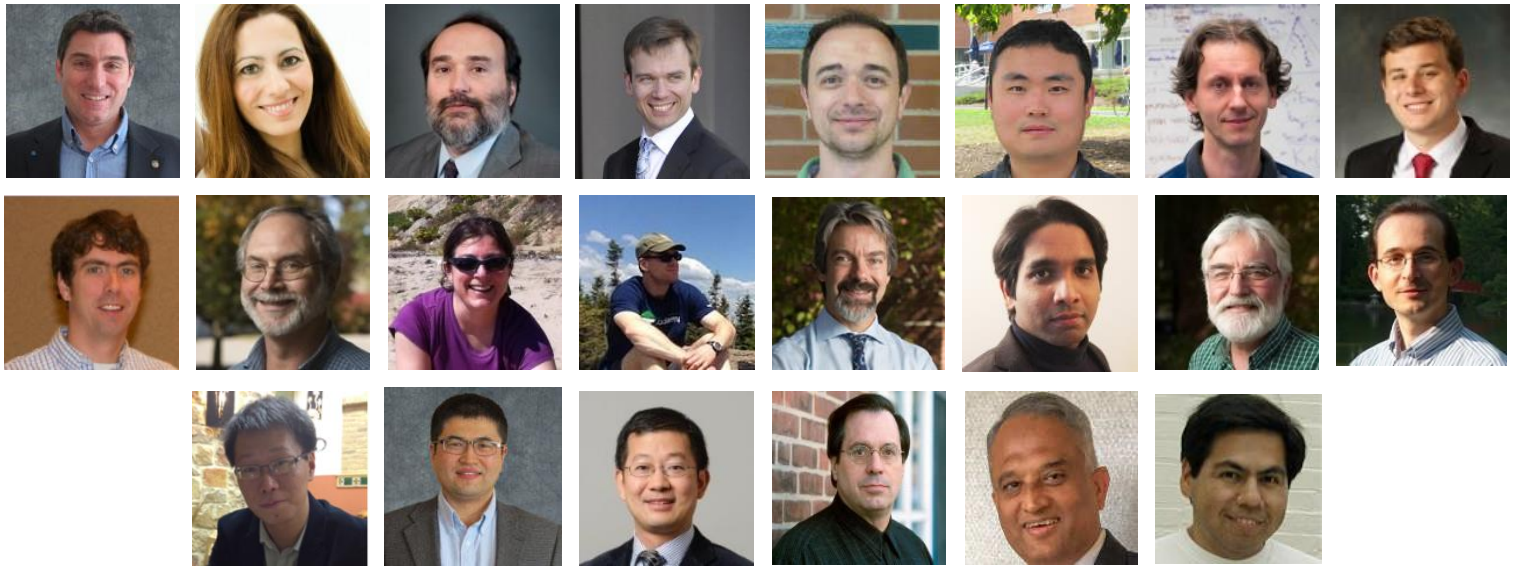
Delivering utility industry-relevant technologies and science-based solutions

"To be the foremost energy utility-academia partnership advancing leading-edge interdisciplinary research and technology assuring reliable power during extreme weather and security events"



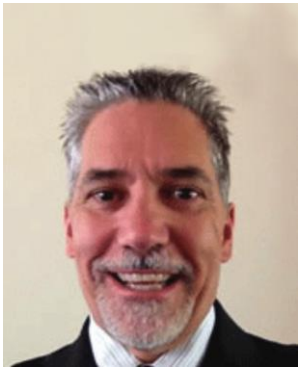
Affiliated UConn Faculty Members

Our Center taps the expertise of 22 faculty members across the UConn School of Business, School of Engineering, and College of Agriculture, Health and Natural Resources.



Advisory Board

Our Board's expertise in industry, government and academia is recognized regionally and nationally for their utility, technology, policy, cyber and leadership expertise.



Doug Dorr
EPRI

Katie Sharf Dykes
CT-DEEP

Bill Hackett
CT-EMHS

Art House
Chief Cyber Security
Risk Officer

David Owens
EEI (retired)

Christina Sames
AGA

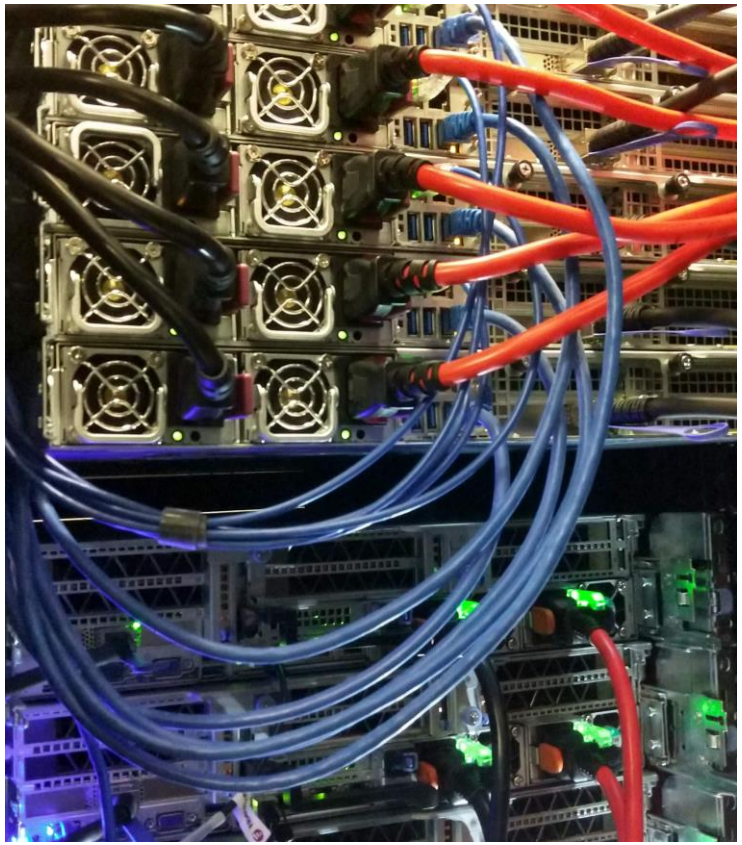
Joe Thomas
AVANGRID

Peter Rothstein
NECEC

Anne George
ISO-NE

Infrastructure

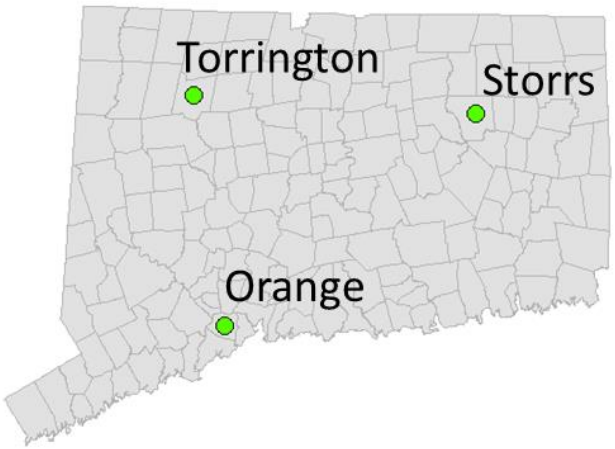
High Performance Computing



- 120+ Nodes
- 2500+ Cores
- 10TB RAM
- 800TB Storage
- Supporting daily weather, outage and flood forecasts and large scale predictive modeling

Tree biomechanics lab

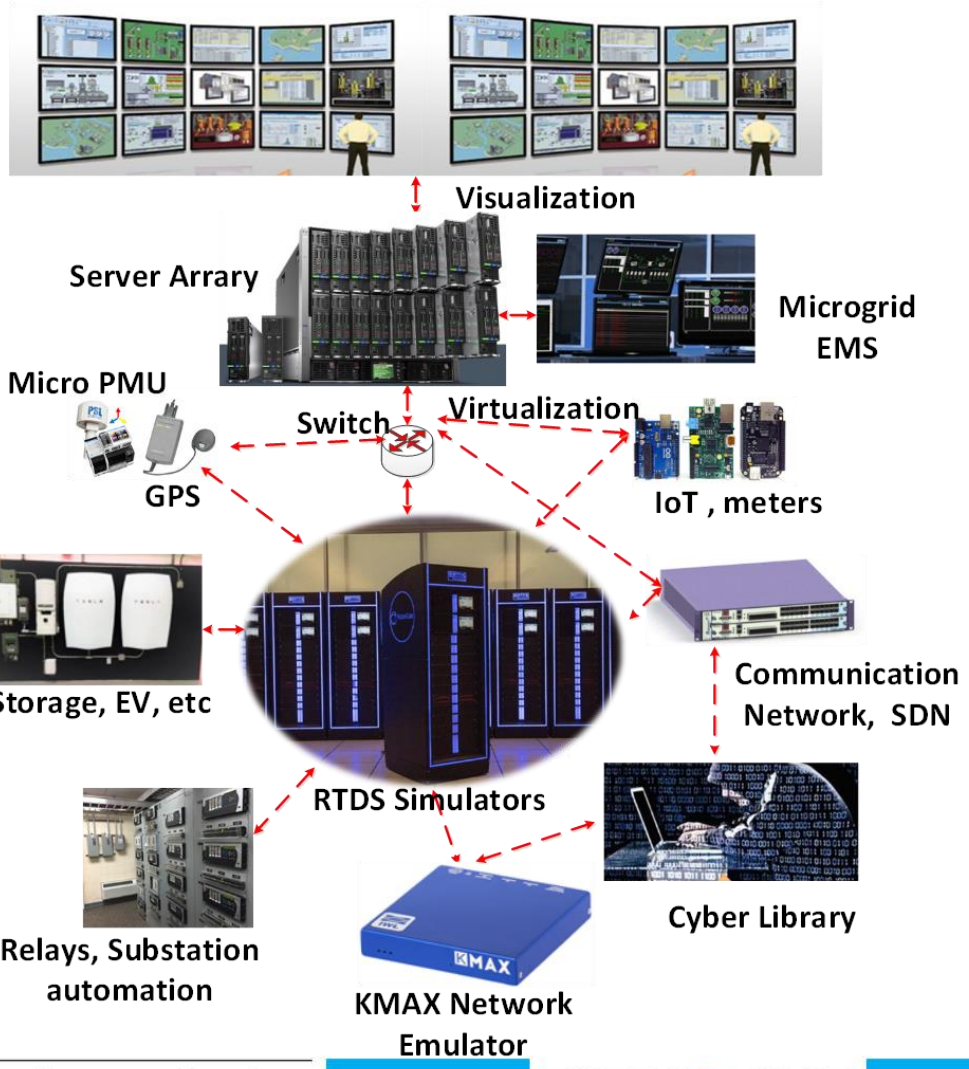
- **Purpose**: monitor tree sway to understand factors that affect tree stability.
- **Sites**: three experimental sites (Storrs, Orange, Torrington) monitoring 41 trees.
- **Equipment**: biaxial clinometers and anemometers.



Power Grid Simulation testbed

Testing and validating:

- integration of distributed energy resources in the power grid,
- grid modernization methods, and
- cybersecurity techniques for utilities



Unmanned Aerial Systems Lab

- **Purpose**: UAS mapping and intrusion detection.
- **Platforms**: 4 platforms including fixed-wing and heavy-lift capabilities.
- **Sensors**: LiDAR, visible to near-infrared camera, thermal, radar.

Key Initiatives Overview

We are driving the innovations and advances that will create the grid of the future – intelligent, interactive, automated, safe.

- Power Grid Storm Readiness *1 & *2
  - High-Resolution Weather Forecasting
  - Outage Prediction Modeling (OPM)
  - Estimated Time of Restoration Modeling
  - Storm Damage Assessment Tools
- Tree and Forest Management *1
  - Tree Risk Mapping from LiDAR
  - Tree Biomechanics Analyses
  - Vegetation Management Best Practices
  - Community Perspectives
- Cyber and Physical Security *1 & *4
  - Anomaly Detection Preventing Malicious Activity in the power grid
  - Unmanned Aerial Vehicles (UAV) Surveillance systems
  - Substation Flooding Protection

- Electric Grid Hardening *1
  - Systems-Based Modeling to Optimize Grid Management
  - Economic Advantages of Improved Reliability and Outage Prevention
  - LiDAR Infrastructure Mapping
- Electric Grid Modernization *1 & *3
  - Safe Integration of Renewables
  - Optimal Storage Technologies & Distributed Generation (micro-pump-storage, CHE, batteries)
  - Forecasting PV Output
  - Grid Analytics – Forecasting loading
  - Electric Vehicles and Pricing
  - Cascading Failures from PV Systems

*1 *Eversource & AVANGRID*
*2 *EPRI*
*3 *ISO-NE*
*4 *DoE & NSF*