

Christopher S.
Edrington, PhD, PE

Energy Conversion
and Integration
Thrust

Electrical and
Computer
Engineering/Center
for Advanced Power
Systems

- **We bring expertise in:**
 - Distributed control for power and energy management
 - Fault tolerant control via advanced methodologies from the actuator to system
 - Advanced methodologies to seamlessly incorporate multiphysics objectives into overall system control
 - tem level
 - Evidence theory approaches to incorporate higher-level functionality to system control for consideration of equipment failure and vulnerability
 - Advanced system monitoring methodologies
 - Real-time Complexity analysis
 - Real-time Stability analysis
 - Sensor placement
 - Analysis on where sensors should be placed and associated computational burdens
 - Awareness in the system to applications such as system reconfiguration, resiliency, and immunity to faults
 - Experience in development of real-time multiphysics models of systems
 - Generators, motors, electrolyzers, wind, PV, fuel cells, power architectures, power electronics, and thermal systems

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- **We bring expertise in:**
 - Coding for real-time control on the following platforms:
 - Texas Instrument DSPs, Altera FPGAs, NI RIO
 - Data acquisition via National Instruments Labview-based systems
 - Real-time modeling via:
 - OPAL-RT, Typhoon, RTDS, and Matlab/Simulink
 - Experience in:
 - Processor in the Loop, Controller Hardware in the Loop, Power Hardware in the Loop based studies
 - Experience in developing Hybrid AC/DC Microgrids and conduction of studies in management of such systems
 - Application of advanced optimization techniques:
 - Crow Search Algorithms (CSA), Particle Swarm Optimization (PSO), Dynamic Programming, and Alternating Direction Method of Multipliers (ADMM)

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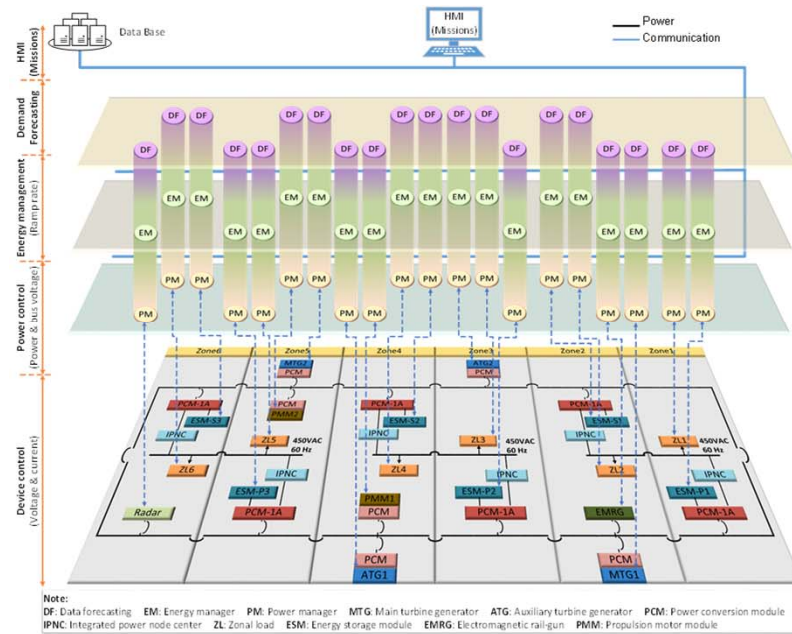
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- **How I'd Like to be Involved in a Smart Cities Project:**
 - Energy and power management, systems awareness, sensor placement, multiphysics system modeling are all directly applicable to instantiation, integration and development of Smart Cities
 - Controls, communications, cyber-physical systems security
 - Reduced Scale Advanced Demonstrators (RSAD)
 - Would like to work synergistically with researchers who are thinking holistically about passive and active systems and their integration and design cycles
 - Would like to work with researchers who are considering integration of:
 - Local and mass transportation
 - Industrial, residential and commercial complexes
 - Medical systems
 - Novel energy systems

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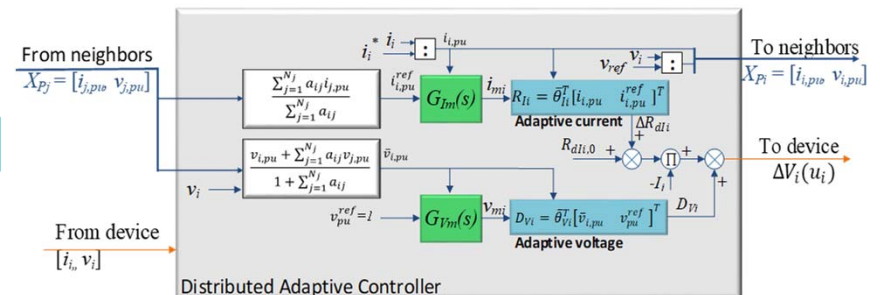
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System level controls and architecture

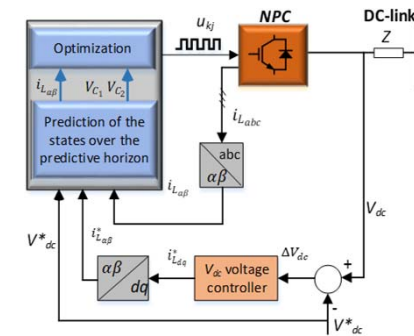
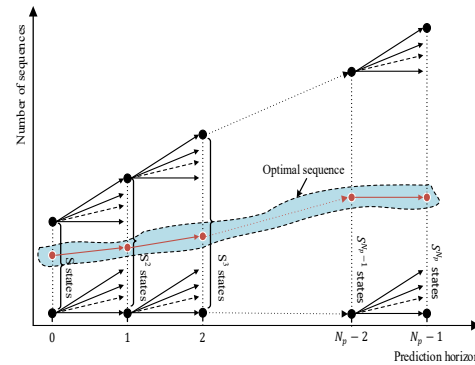
Detailed control implementation



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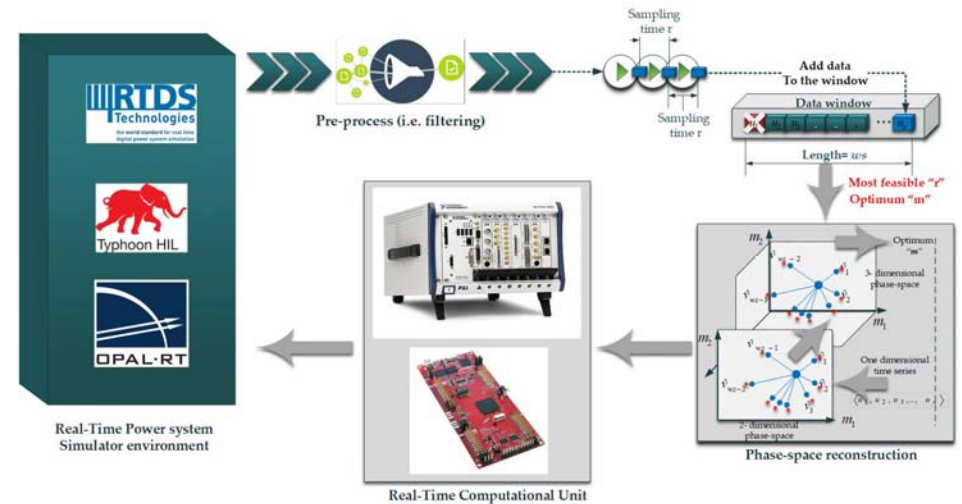
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Sequenced-based controls and architecture

System Awareness

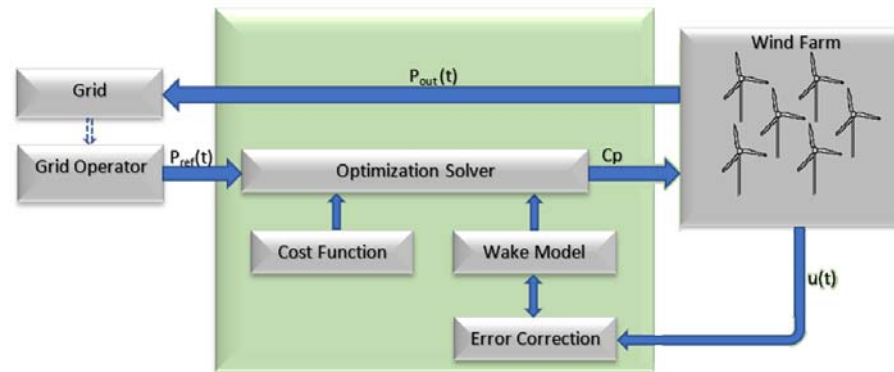
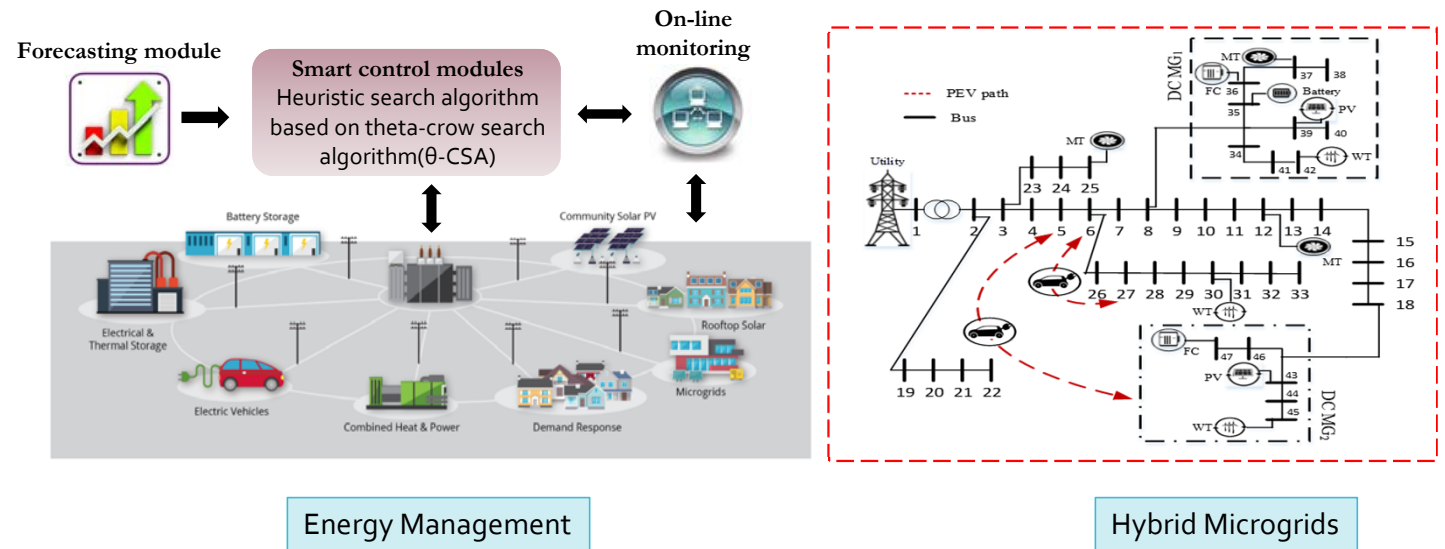


Collaborative Collision: Smart Cities 2018

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- **Team:**

- Dr. Tuyen Vu, Research Faculty I
- Dr. Hesam Vahedi, Postdoctor
- Mr. David Gonsoulin, PhD student
- Mr. Dallas Perkins, PhD student
- Mr. Huawei Yang, PhD student
- Mr. Gokan Ozkan, PhD student
- Ms. Behnaz Papari, PhD student
- Dr. Jim Stright, PhD student

- **Relevant Grants:**

- NSF FREEDM
- NSF CREDENCE
- ONR Distributed Controls
 - 6.1 and 6.2 efforts
- ONR Electric Ship Development Consortium
 - 6.2 efforts

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- **Relevant Publications:**

- F. Diaz, T. Vu, D. Gonsoulin, H. Vahedi, **C. S. Edrington**, Enhanced Performance of PV Power Control using Model Predictive Control, *Solar Energy (accepted for publication)*.
- B. Papari, **C. S. Edrington**, (2017), Effective Energy Management of Hybrid AC-DC Microgrids with Storage Devices, *IEEE Transactions on Smart Grid, (IEEE Early Access)*.
- B. Papari, **C. S. Edrington**, and F. Kavousi-Fard, (2017), An Effective Fuzzy Feature Selection and Prediction Method for Modeling Tidal Current: A Case of Persian Gulf, *IEEE Transactions on Geoscience and Remote Sensing, (IEEE Early Access)*.
- F. Ferdowsi, H. Vahedi, **C. S. Edrington**, and T. El-Mezyani, (2017), Dynamic Behavioral Observation in Power Systems using Real-time Complexity Computation, *IEEE Transactions on Smart Grid, (IEEE Early Access)*.
- T. Vu, D. Gonsoulin, F. Diaz, **C. S. Edrington**, and T. El-Mezyani, (2017), Predictive Control for Energy Management for Ship Power Systems under High-power Ramp Rate Loads, *IEEE Transactions on Energy Conversion, vol. 32, no. 2, pp. 788 – 797*.
- T. Vu, D. Perkins, F. Diaz, D. Gonsoulin, **C. S. Edrington**, and T. El-Mezyani (2017), Robust Adaptive Droop Control for DC Microgrids, *Electric Power Systems Research, vol. 146, pp. 95 – 106*.
- T. Vu, F. Diaz, S. Paran, T. El-Mezyani, and **C. S. Edrington** (2017), An Alternative Distributed Control Architecture for Improvement in the Transient Response of DC Microgrids, *IEEE Transactions on Industrial Electronics, vol. 64, no. 1, pp. 574 – 584*.
- A. Salmani and **C. S. Edrington** (2015), Small-signal Stability Assessment of a Single-phase Solid State Transformer through PHIL Experiment, *International Journal of Power Electronics, vol. 7, no. 3/4*.
- M. Cupelli, F. Ponci, G. Sulligoi, Andrea Vicenzutti, **C. S. Edrington**, T. El-Mezyani, A. Monti (2016), Power Flow Control and Network Stability in and All Electric Ship, *Proceedings of the IEEE, vol. 103, no. 12, pp. 2355 – 2380*.
- A. Salmani, N. Asr, **C. S. Edrington** and M. Chow (2015). Online and Offline Stability Analysis Methods for the Power Electronic-based Components in Design and Operational Stages, *IEEE*