ENERGY, POWER, SUSTAINABILITY & INTELLIGENCE (EPSI) – FACILITIES, INFRASTRUCTURE, AND RESEARCH

Eminent Scholar Chaired Professor

Dr. Arif Sarwat

Principal Investigator (PI) and Director of FPL-FIU Solar Facility and

Energy, Power, Sustainability, and Intelligence (EPSi) Group

eps.fiu.edu

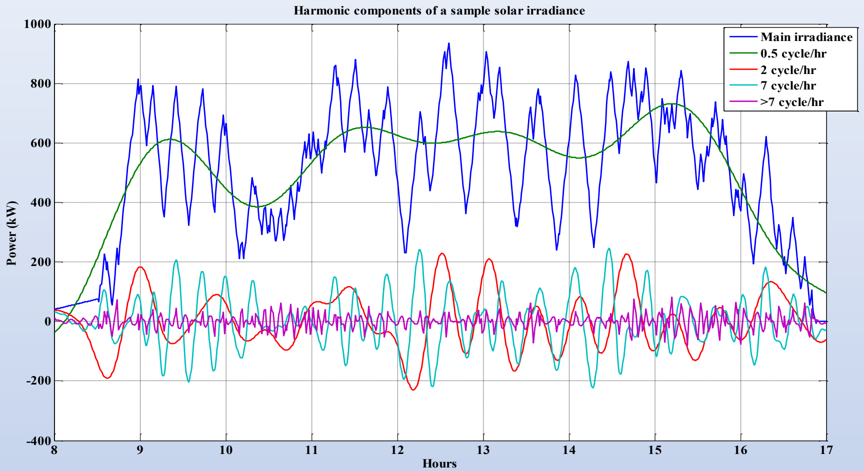
Our Mission, Academics, Research, and Service

To bring together an ***interdisciplinary team of researchers, industry partners and community*** *to address challenges in energy, power, environment and policy making: design & develop inventive solutions, to* ***train next generation professionals with industry and state collaboration*** *on education and research.*

- ❖ Student pathways for job and workforce training in distribution center and edge device technologies.
- ❖ New Masters in Energy & Cybersecurity program launched
- ❖ More than $ 10 Million funding in last 4 years
- ❖ About 50 Students, Post-Doctorate Scholars & Researchers
- ❖ Multiple Outreach Activities, Publications, Seminars & Courses
- ❖ Top collaborators: NREL, DOE, NSF, GE, FPL/NextEra & Other Universities
- ❖ Almost all students get jobs before or within 3 months of graduations
- ❖ Internships at leading companies and labs

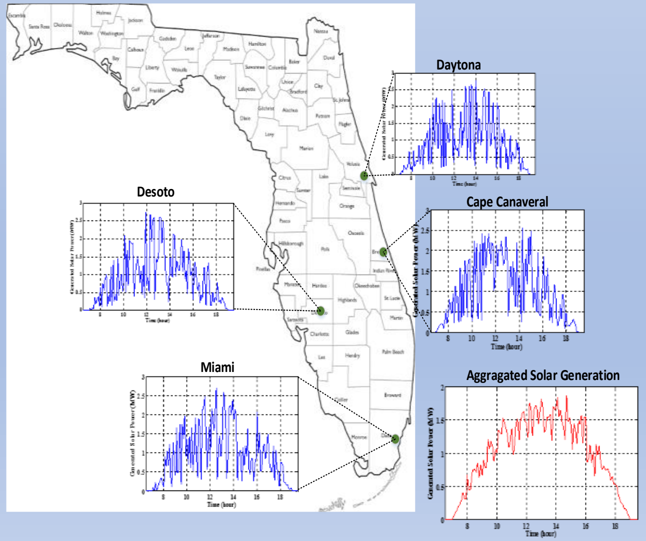
NSF CAREER For High Penetration Renewables

The Problem

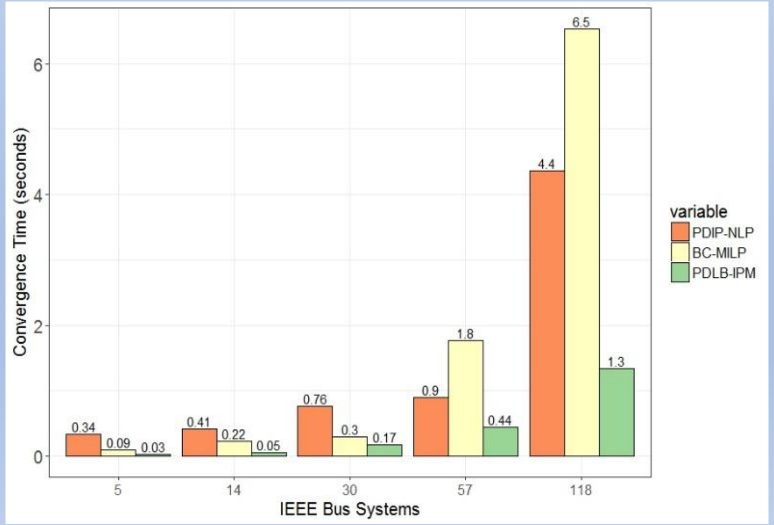


Task	Challenges	Existing/Baseline	Innovation
Task I	Fast AC Optimal Power Flow analysis for optimal response towards fluctuations in PV generation	Use heuristics that converge fast but are inaccurate	Relaxed Mixed Integer Linear Programming (RMILP) using Primal-Dual Log Barrier Interior Point Method
Task II	Renewable energy forecasting and to determine the optimal mix at high levels of solar penetration	Weather based and persistence forecasting, consider very limited features, non-localized models	Long Short Term Memories Deep Learning with step-backs with more features
Task III	Predictive control of PV generation and intermittencies without jeopardizing overall system reliability and operation	Existing methods consider renewable buses as negative load P-Q bus.	Integrating off-the-shelf SCESS and BESS controller modules with the centralized controller; use of PV Aggregation-based Fleet Management models
Tasks IV & V	Verification, validation and testing of the developed solution on a reliable test-bed	Data collected before the implementation	Documenting improvements and fine-tuning if required

PV Aggregation



High-Speed ACOPF



Benefits

- ❖ Greater operational visibility into distributed renewable mix
- ❖ Enhanced grid reliability and stability even under high penetration scenarios
- ❖ Superior control over renewable generation and intermittencies
- ❖ Maximal use of deployed renewables

AI-based Renewable Microgrid

A roadmap for future renewable smart cities

Based on 10 years of research and development by EPS.

Capabilities:

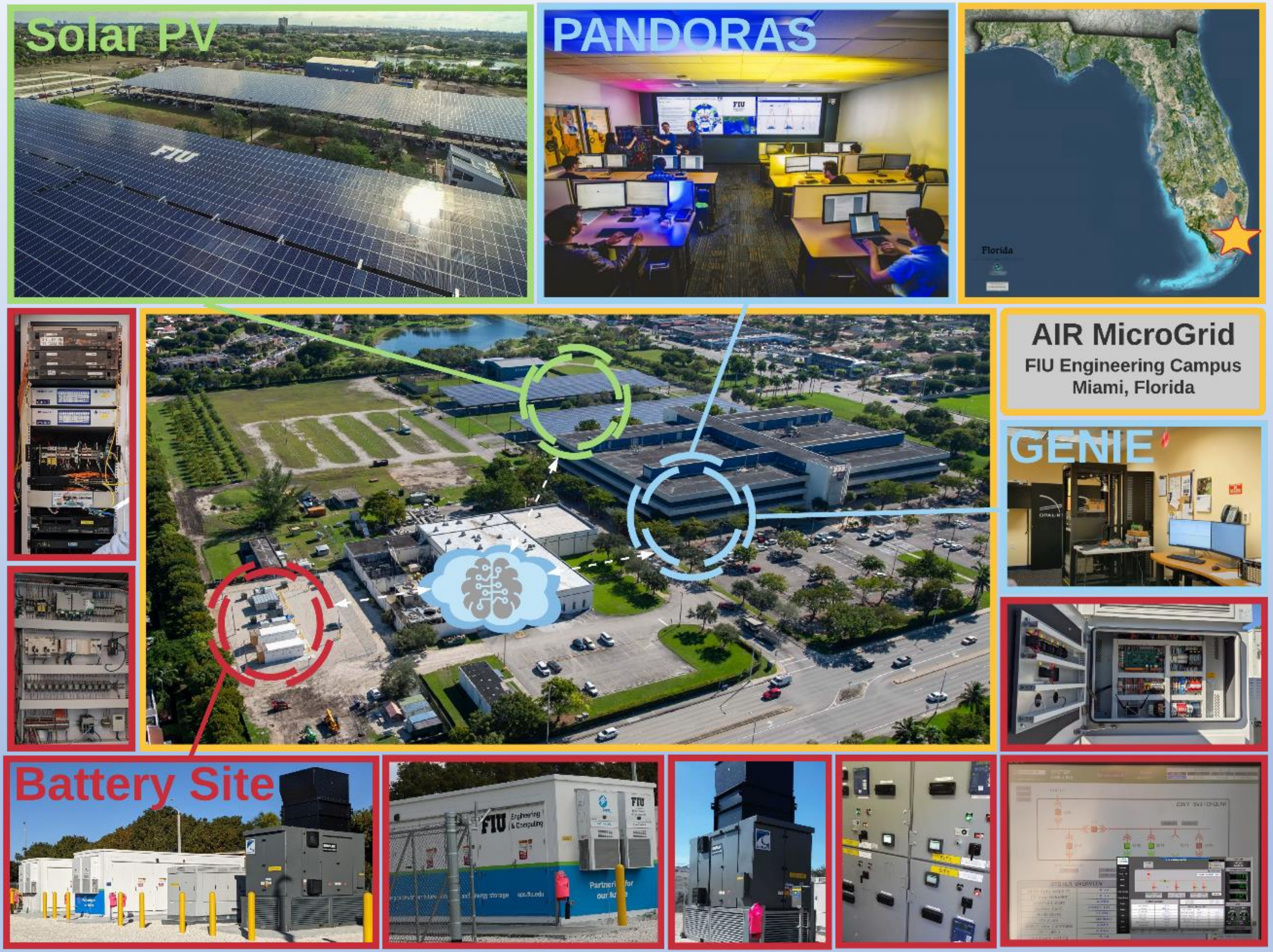
- ➢Can run as Independent Power Plant
- ➢Grid-Forming of Main AC Bus
- ➢3 Minute Black Start
- ➢Voltage and Frequency Support
- ➢Fully AI Control Logic for Optimization

Principal Investigator (PI): Dr. Arif Sarwat

FPL

NEXTera ENERGY

FIU | Energy Power & Sustainability
FLORIDA INTERNATIONAL UNIVERSITY

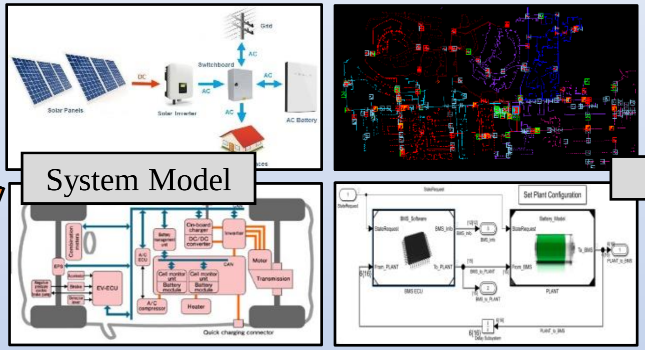


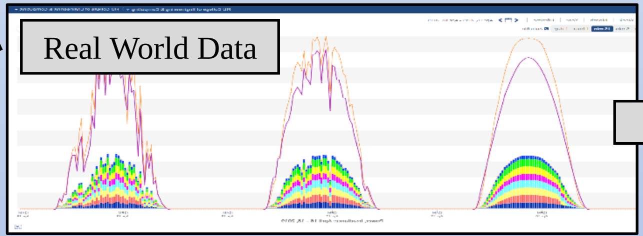
Real-Time Simulation

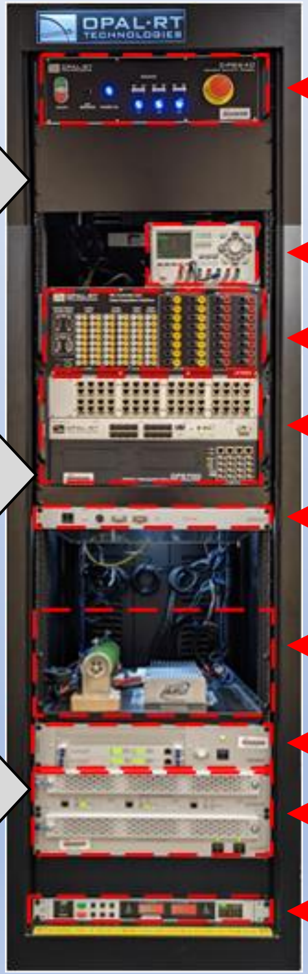
Grid ENergy Intelligence and Exploration (GENIE) Lab

GENIE lab can model and simulate actual power systems in real time using real world data in order to design and validate hardware controllers and machine learning algorithms for increased reliability and resiliency.

- Modeling of AIR Microgrid electronic components, and electric vehicles.
- Standard industry simulation software such as MatLab/ Simulink
- Implements standard communication protocols for high modularity.







Bench Power Supply/ Safety Shutoff

Programmable Bench Power Supply

Device Data Acquisition

OP5700 Real-Time Simulator

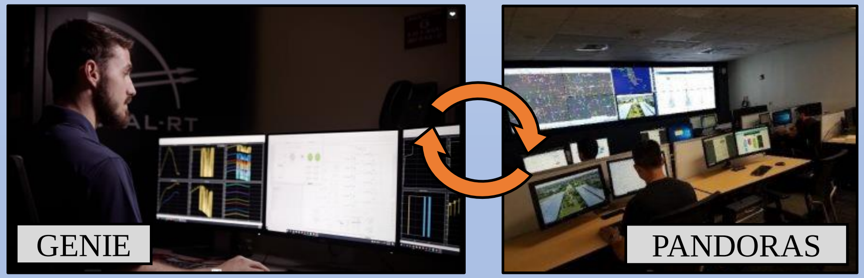
Fault Simulation Unit

Hardware Setup Space

Temperature Simulator

Battery Cell Simulator

DC Bench Power Supply



Connectivity between the **Proactive ANalytics and Data-Oriented Research on Availability & Security (PANDORAS)** Lab and the **Grid ENergy Intelligence and Exploration(GENIE)** Lab allows EPSi students the ability to seamlessly control real-time emulated systems for command and control room operations.

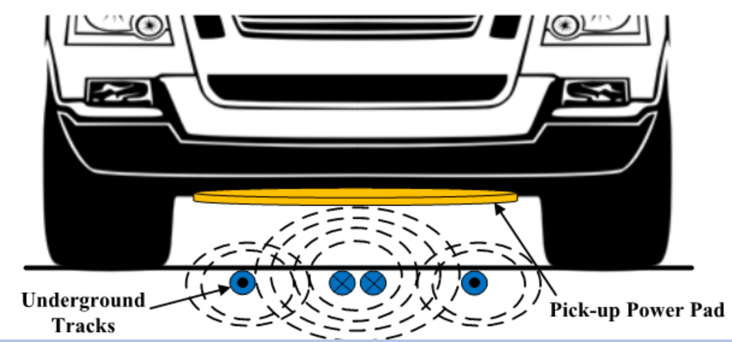
Wireless Power Transfer (WPT)

Contactless Electric Vehicle (EV) Charging Based on WPT

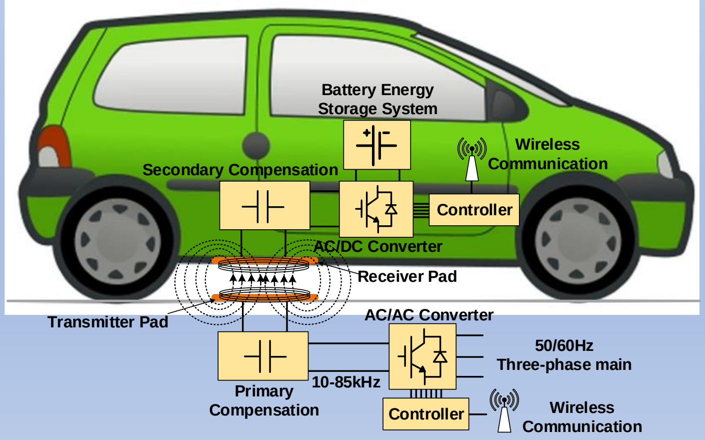
- Automated charging process without interaction of the driver: No cables to handle inside or outside the car.
- It does not get affected by rain, snow, ice, dust, and dirt. It is clean and safe way of charging electric vehicles.
- Bidirectional IPT systems can be used to make grid-to-vehicle (G2V) and vehicle-to-grid (V2G) connections.

Dynamic WPT Systems Structures

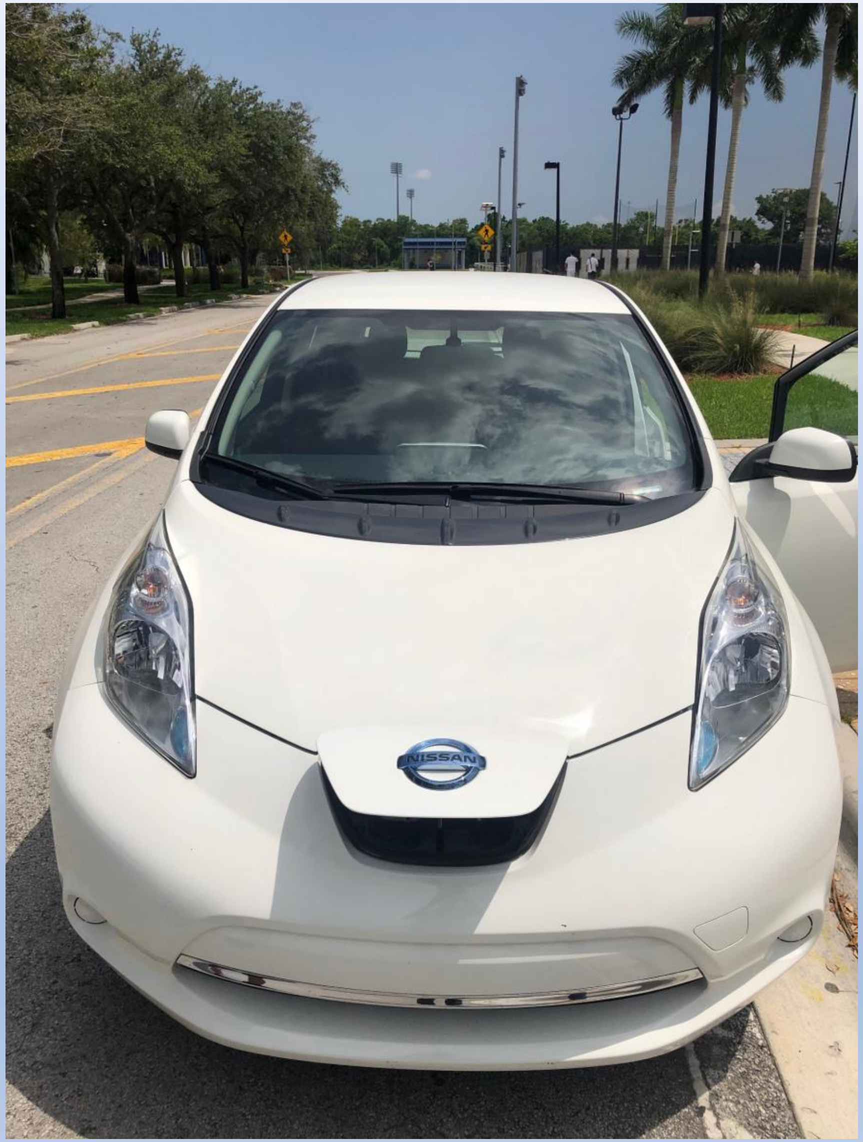
- It can be implemented on highways (dynamic or in-motion wireless charging) unlimited range for EVs without plugging-in or stopping for recharging.
- This technology can revolutionize the future transportation systems.
- Reduces the size, weight, and cost of the battery, the most expensive part in an EV.



A typical WPT based dynamic EV charging system.



A typical WPT based static EV charging system.



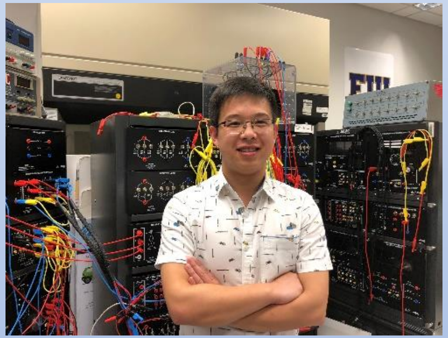
The EPSi Past Networking

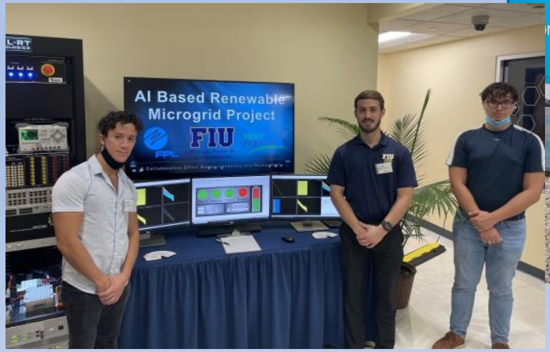
Best Paper Awards

Continued FPL-FIU Partnership (20 years+)

NextEra/FPL: Largest renewable energy producer in the world)

Internships at the National Renewable Energy Laboratory and Argonne National Lab





2021 FIU-FPL AIR Microgrid Unveiling Dr. Mark Rosenberg and CEO Eric Silagy

The EPSi Diverse Group

For more information on the AIR Microgrid and Solar Research, please contact **PI Dr. Arif Sarwat.**

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