EE3080
DESIGN AND INNOVATION
PROJECT

Programme:
Smart and Micro Grids for Integration of Renewable Energy Sources

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Major Changes and Challenges In Power Systems

- Large complex systems
- More uncertainties and intermittences
- Multiple sources in generation and load sides

Challenges

Grid Scale varies from Home-level to the City-System-Level

National Grid

Wireless (such as Zigbee, Wi-Fi, WiMAX and 4G LTE) or Wired (such as power line communication and optical communication) technology

Communication Networks in each layer for H-EMS

Wireless (such as Zigbee, Wi-Fi and WiMAX) technology

Home-EMS

Building-EMS

Area-EMS

System-EMS

City

Home

Building

Area

Micro Grids

National Grid
Various DC/AC and DC/DC conversion techniques for integration of electric vehicles, photovoltaic, fuel cell, battery storage system, wind and wave turbine etc. to micro grids and utility grid. Design and monitoring of AC and DC Micro Grids with renewable sources.

Energy Management Systems from Homes, buildings, towns and grid; Smart metering and monitoring system design. Design of smart grids with high energy efficiency.

Each project requires the students from disciplines: Power, Power Electronics, Control and Instrumentation, Communication and Information, computer and sensor network.
Smart Grid Projects at Laboratory for Clean Energy Research

Prof H B Gooi, Prof So Ping Lam and the research team

- Integration of electric vehicles to grid using the installed fast and slow charging stations
- Integration of photovoltaic, fuel cell, battery storage system and synchronous generators with the microgrid and test them with the Automatic Generation Control function designed specifically for microgrids.
- Incorporating Home/Building Energy Management System, load aggregation and Static Frequency Converter into Demand Response Management.
- Integration of wind turbine and wave energy simulator to grid for remote control and monitoring.
- Setting up Network Management System and Consumer Energy Portal for NTU Campus.
- Understand the structure of a smart grid and its applications for future power systems.
- Software Programming techniques: NI LabVIEW, MATLAB, Programmable Logic Controller (PLC), advanced optimization software tools and Oracle/SQL Database.
Professors and Research Areas in Power Engineering and Other Division…

- Prof Tseng Kingjet: Tidal Stream Energy Systems, Energy Storage for Renewables
- Prof Wang Youyi: Control techniques for power and energy systems, electric drive systems, information storage systems, fuel cell systems, renewable energy systems.
- A. I. Maswood: Converter topology for hybrid Wind & Solar Energy; Novel DC-DC buck-boost Converter for solar/Fuel Cell optimal power traction
- Dr Zhao Jiyun: Electricity generation using thermoelectric effect on airplane
- Gilbert Hock Beng Foo: Wing Generation System: Maximising PV Array System Efficiency under Rapid Shading Conditions.
- Prof Soong Boon Hee: Energy consumption monitoring system for Green Building
- Prof Law Choi Look: Ultra wideband impulse radio based wireless sensor network for building energy management system
- Prof Justin Dauwels: Smart data mining tools for predicting electricity load and consumer behavior; Visualization tools to explore network dynamics in smart grids.
- Prof Zhong Wende: Smart grid and energy management system.
- More projects will be proposed by other professors
Smart Solar Penal-Design (DIP13)
SMART SOLAR PENAL-DESIGN (DIP13)
HYBRID DC/AC MICRO GRID (DIP13)

PV PANEL → DC/DC BOOST CONVERTOR → DC/DC BOOST CONVERTOR → DC/DC BUCK CONVERTOR → DC LOAD (LED) → DC LOAD (FAN)

12V BATTERY → DC/DC BUCK CONVERTOR

24V DC BUS

230V AC BUS

AC SOURCE → AC LOAD (LAMP)

AC/DC RECTIFIER → DC/DC BUCK CONVERTOR → DC/DC BUCK CONVERTOR → DC/DC BUCK CONVERTOR

24V DC BUS

DC/AC INVERTOR
Thanks

Join the programme for future energy and environment challenges