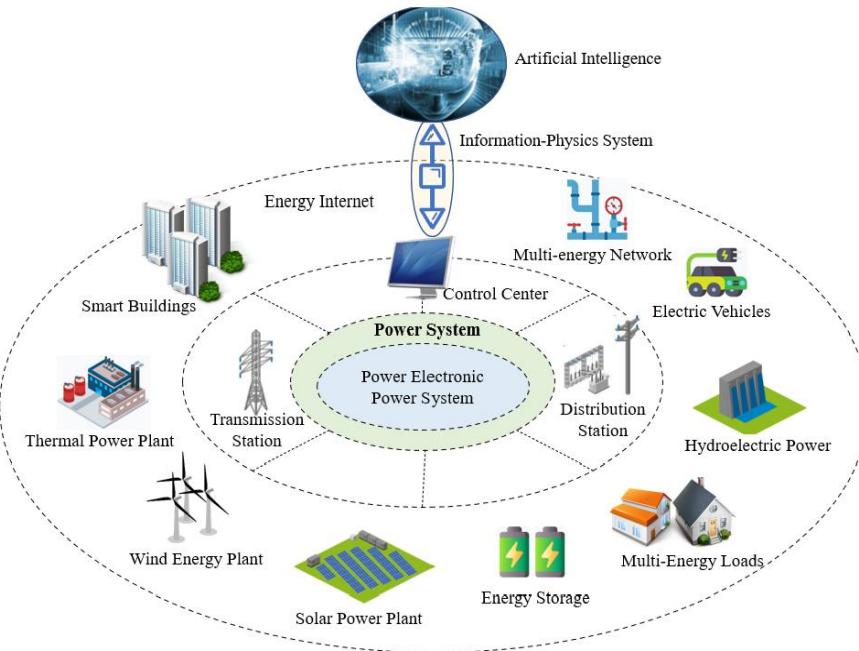




Renewable Energy Research Group-AI for Energy

Core Research Areas

- Integrated Energy System Operation
- Renewable-EV Microgrid Operation and Control
- Energy Internet
- Multi-Buildings Energy Management
- Distribution Network Voltage Control
- Design for Wind Power Converter
- Stability Prediction and Control of Wind Power Converter



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AI for Renewable Energy System

Integrated Energy System Energy Management

The diagram illustrates the integrated energy system energy management process. It starts with a heat and power integrated network where electricity, heat, and water are managed. This feeds into an integrated energy system management model. The model includes a system operator, energy generation, and load demand. It uses a PPO-based energy management model to handle wind power distribution, electricity price, and load demand. The process involves data normalization, training, and updating the model to minimize error and maximize reward.

Distribution Network Voltage Control

This section shows a multi-agent reinforcement learning framework for distribution network voltage control. It consists of a multi-agent environment, a power distribution network, and a dynamic simulator. Agents interact with the environment through a graph representation and a bus voltages after the control. The framework includes a transformer-based Q-functions, a transformer-based policy network, and feature extraction by GNN. The proposed method is compared with MADDPG, DDPG, DC, and DRL.

Multi-Buildings Energy Management

The diagram depicts a multi-buildings energy management system. It features a distribution power network, buildings, and a multi-building environment. The system uses an actor-critic framework for decentralized execution, shared critic, and centralized training. It includes a state information of agent N, output of PV, charging/discharging power of ES, operation of HVAC, and action of agent N. Performance metrics like cumulative reward of episode and voltage profile over time are shown for the proposed method and MATD3.

Stability Prediction and Control of Wind Power Converter

This section focuses on the stability prediction and control of wind power converters. It presents a hybrid model combining data-based (ANN) and physical-based models. The physical-based model includes a criterion model for stability analysis. The experimental setup shows a dSPACE hardware connected to a PWM controller and a wind power converter. Various plots show stability regions, real impedance, predictive impedance, and other performance metrics.

Hybrid Renewable-EV Microgrid Energy Management

The diagram details a hybrid renewable-EV microgrid energy management system. It includes a main grid, micro-grid, and various energy sources like PV, wind turbines, and conventional DG. EVs are integrated into the system. A TD3-based agent framework is used for energy management, involving a critic network, policy gradient, and target actor network. The framework handles electricity generation, storage, and consumption, along with EV charging and discharging.

Energy Internet

The Energy Internet architecture is shown as a hierarchical system. At the bottom layer are microgrid clusters (Microgrid 1 to n). These connect to a LEM platform, which then connects to an upper layer and finally to the main grid. The architecture supports information flow and energy flow. A MADRL-based energy management framework is used for centralized training and decentralized execution across different microgrids.

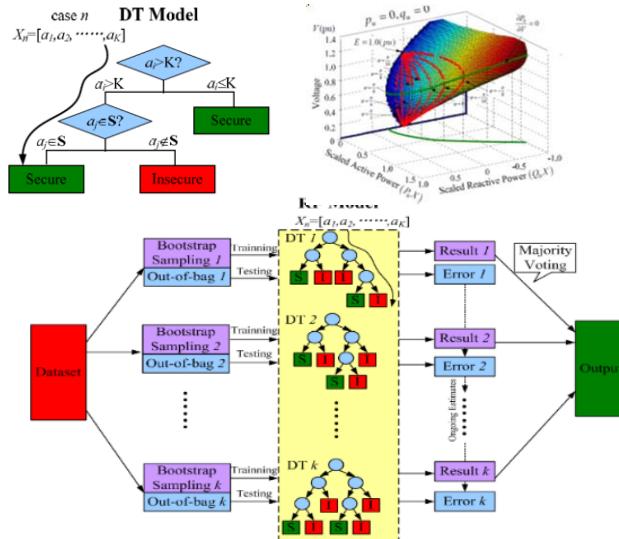
Neural Network -based Fast Economic Dispatch

This section shows a neural network-based fast economic dispatch system. It includes a complex power system diagram with various components like compressors, valves, and pumps. The neural network architecture consists of input layers, hidden layers, and output layers for continuous and binary dispatch. Loss functions like MSE and JCE are used to train the network. The system aims to optimize power/gas output, nodal pressure, and pipeline flow.

Design for Wind Power Converter

The diagram compares the design process for wind power converters. The AI-D Method (Fully Automatic) uses Artificial Intelligence-Based Design for Power Converter, involving design objectives, analysis, deduction, and optimization. The Traditional Method (Human-Dependent) is based on mathematical modeling and numerical solutions. Tools used include MATLAB/Mathematics, PLECS/Ltspice/Matlab, and Deep Learning/Artificial Neural Network.

Dynamic Security Assessment and Preventive Control



Health Monitoring and Fault Diagnostics of Wind Turbines

