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Power Flow Optimization and Distributed Electric Vehicle Charging Control in Smart Microgrids

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Introduction

- Growing use of Electric Vehicles (EVs)
- Importance of smart microgrids
- Challenges of integrating EVs into the power system
- Goal of the presentatio

What are Smart Microgrids?

- Definition
- Components: DER (Distributed Energy Resources), ESS (Energy Storage Systems), controllers, sensors
- Advantages: flexibility, reliability, energy efficiency

Challenges in EV Charging

- Peak loads
- Voltage disturbances
- Limited capacity of the distribution network
- Imbalance in consumption

Concept of Power Flow Optimization

- DC and AC Optimal Power Flow (OPF)
- Objective: minimize losses, maximize efficiency
- Constraints: voltage, current, capacity

Role of Distributed Control

- Decentralized approaches
- Agent-based systems and local decision-making
- Communication networks and cybersecurity

Algorithms and Methods

- Optimization methods:
  - Linear/Nonlinear programming
  - Stochastic optimization
  - Machine learning (RL, Neural Networks)
- Examples of charging control strategies: V2G (Vehicle-to-Grid), TOU (Time-of-Use)

Challenges and Future Work

- Real-world implementation issues: regulation, interoperability
- Need for standards and further research
- Role of users and incentive mechanisms

Conclusion

- EVs as a key component of future energy systems
- Integration requires advanced management and optimization
- Potential of smart microgrids for a sustainable energy future