Hybrid Distribution Optimal Power Flow

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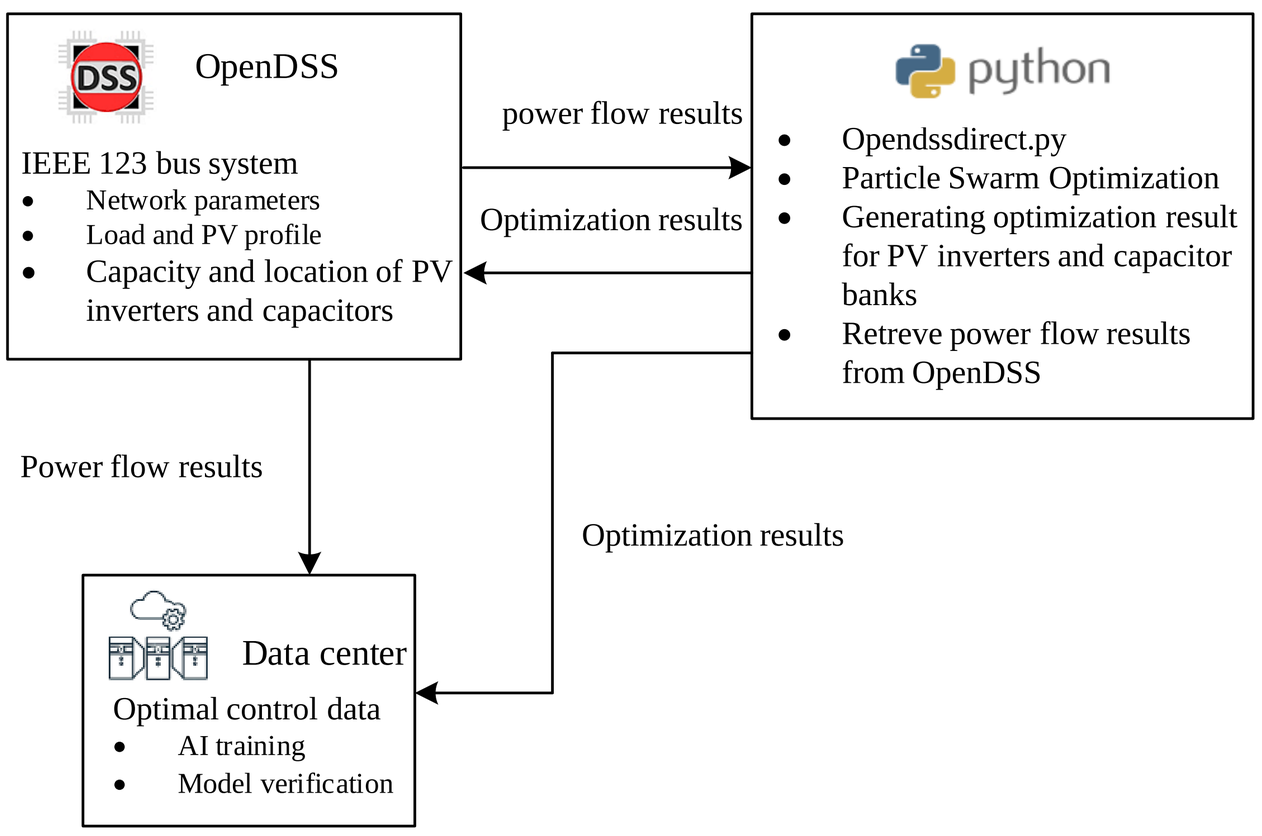
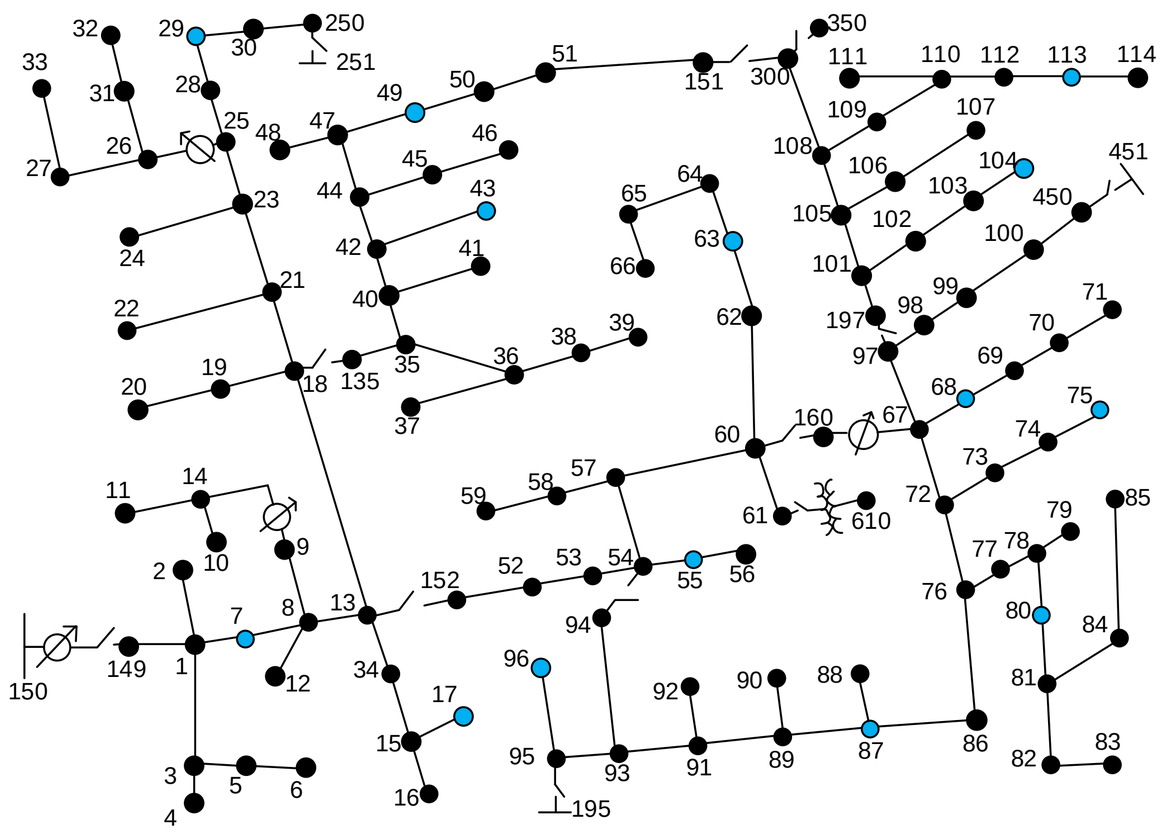
Introduction

- The penetration of PV generation in distribution systems is growing rapidly.
- Distribution Optimal Power Flow (D-OPF) aims to determine the optimal control of all devices in distribution system
- The contribution is to develop cutting-edge voltage control algorithms that have satisfactory control performance in presence of high penetration of fast-varying renewable generation
- Hybrid-D-OPF that integrates the physics-based approach with learning-based approach can offer promising avenues for real-time online control.

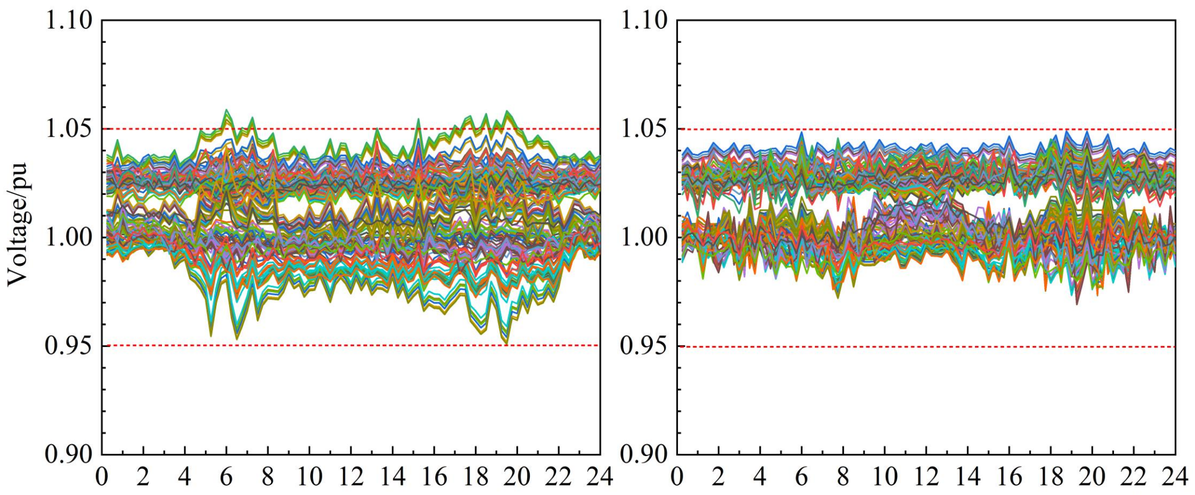
Hybrid D-OPF Framework



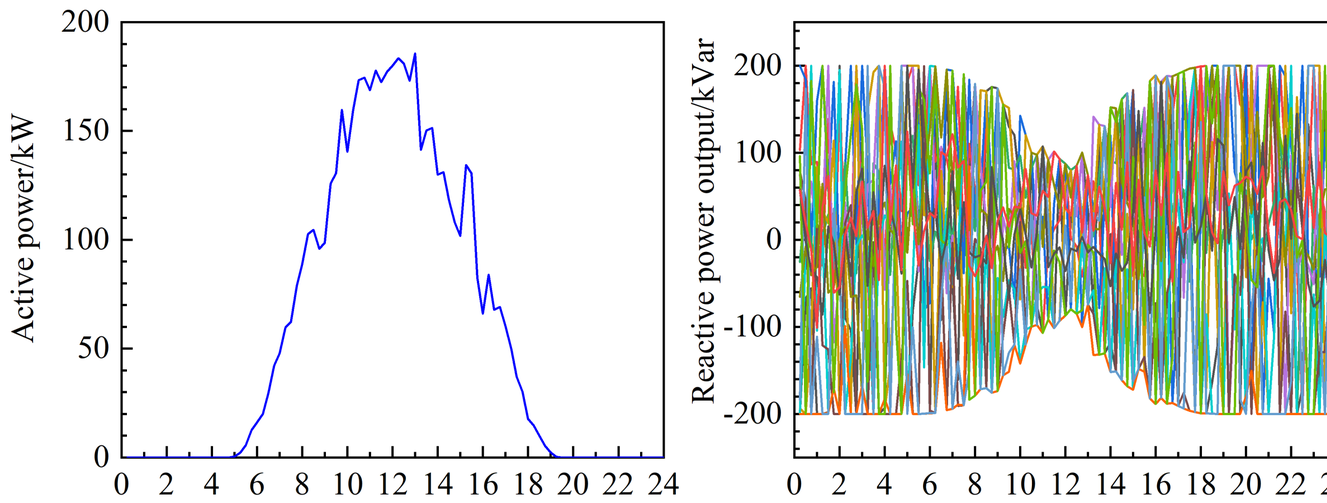


- Hybrid D-OPF algorithms developed in Python, distribution network model built in OpenDSS
- OpenDSS interacts with Python via Opendssdirect.py, optimal results are stored for learning-based approaches
- The objective of Hybrid D-OPF is to regulate the bus voltages in the allowed range while minimize power losses
- Performance of Hybrid D-OPF algorithms is evaluated by simulations on IEEE-123 benchmark system

Simulation Results



Voltage profile in Hybrid-D-OPF



PV active/reactive power output

- Bus voltages are regulated in the allowed range [0.95, 1.05] by the Hybrid D-OPF algorithms
- PV inverters operate at MPPT mode, active/reactive power output constrained by PV inverter capacity

Conclusion

- The proposed Hybrid D-OPF can successfully remove voltage violations and regulate bus voltages in the allowed range.
- The safe and reliable operation of DN can be guaranteed by the proposed algorithm.