DTU 7k Bus Active Distribution Network

Overview and Features

About myself:

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Ph.D. Research Topic: Wind Power Plant control in Future Active Distribution Network

Research Interest: Power system/ power plant level optimization/control, role of renewable energy sources in the future power systems

Education:
M.Sc. In Power Engineering from Technical University of Munich, Germany
B.Tech. in Electrical and Electronics Engineering from Visvesvaraya National Institute of Technology, Nagpur, India

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Wind Power Plant Support in Active Distribution Networks

A massive amount of investment in distributed renewable generation is forthcoming in the future distribution grid

Challenges

Limited Observability

Impact on the network operation and control

Impact on TSO/DSO interface

DTU 7k-Bus Active Distribution Network
- Total 7000 buses
- Spans over 3 voltage levels
- Generation and load time-series for a year
- 150 MW of Wind + 25 MW of PV

···· 400V		□ Wind		■ Household	
— 10kV		■ Misce.		■ Agricultural	
□ Solar		■ Commercial		■ Uncategorized	

Objective:

Coordinated Control of different network assets (WPPs at 60 kV, OLTCs, VRs, etc.) for optimal operation of distribution network by co-simulating MV-LV grids while incorporating uncertainty and stochasticity from weather dependent generation and loads.
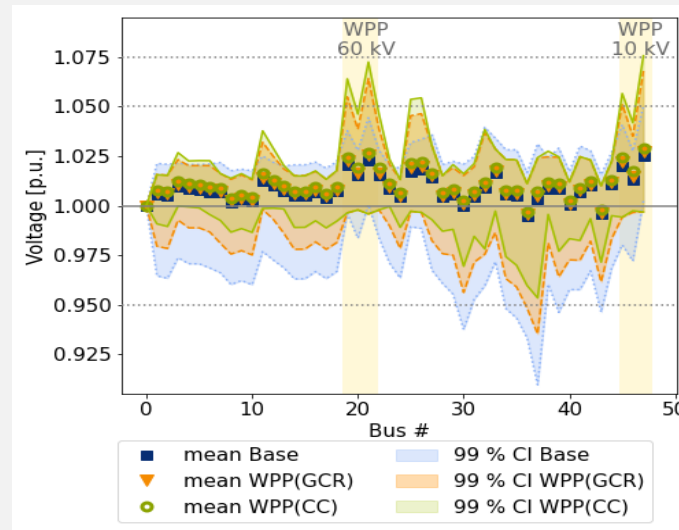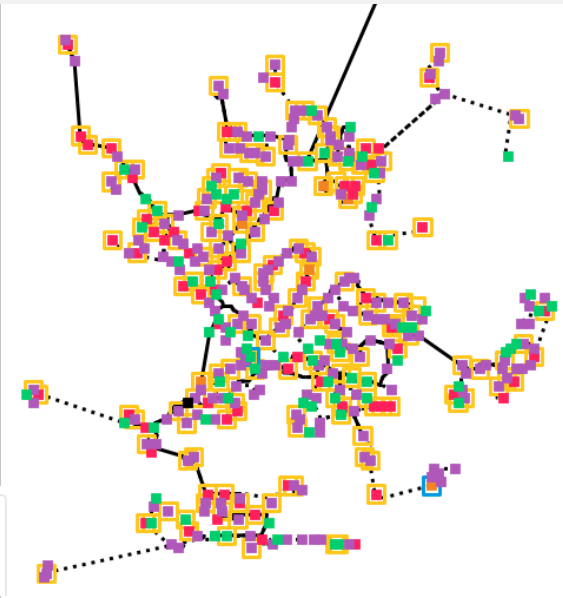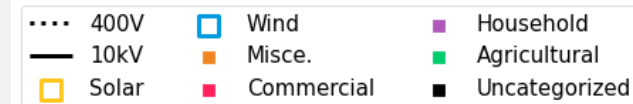
Opportunities

Coordination between TSO/DSO

Large amount of data and detailed models

Control of available network assets with RES

- Energy Losses in 60kV network decrease by ~ 5 % with WPP support.
- Voltage profiles in the distribution grids improve with WPP support

DTU 7k-bus Active Distribution Network

A multi-voltage level active-distribution network (ADN) model	60kV-10kV-400V	
	400 V nodes	6727
	10kV/400V substations	300
	60kV/10kV substations	20
Large share of weather-dependent RES	PV: 25 MW Wind: 107 MW at 10kV-0.4V + 45 MW at 60kV	
Load time-series based on real network data	≈ 1year with 1 hour resolution	
Generation time-series based on meteorological data	≈ 1year with 1 hour resolution	
Flexibility to incorporate additional network assets to investigate performance of ADN	Possible assets to incorporate: CHP, EV, Storage, etc.	

Accepted Paper in IEEE: '*Multi-Voltage Level Active Distribution Network with Large Share of Weather-Dependent Generation*'
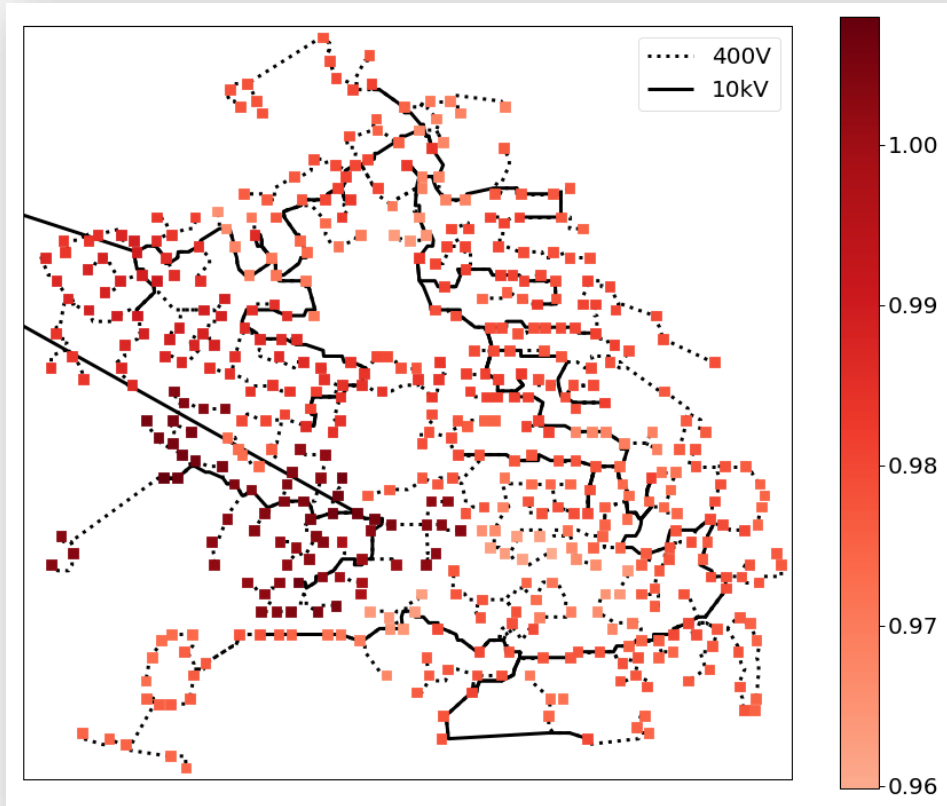
60kV-10kV-400V Networks: Topology
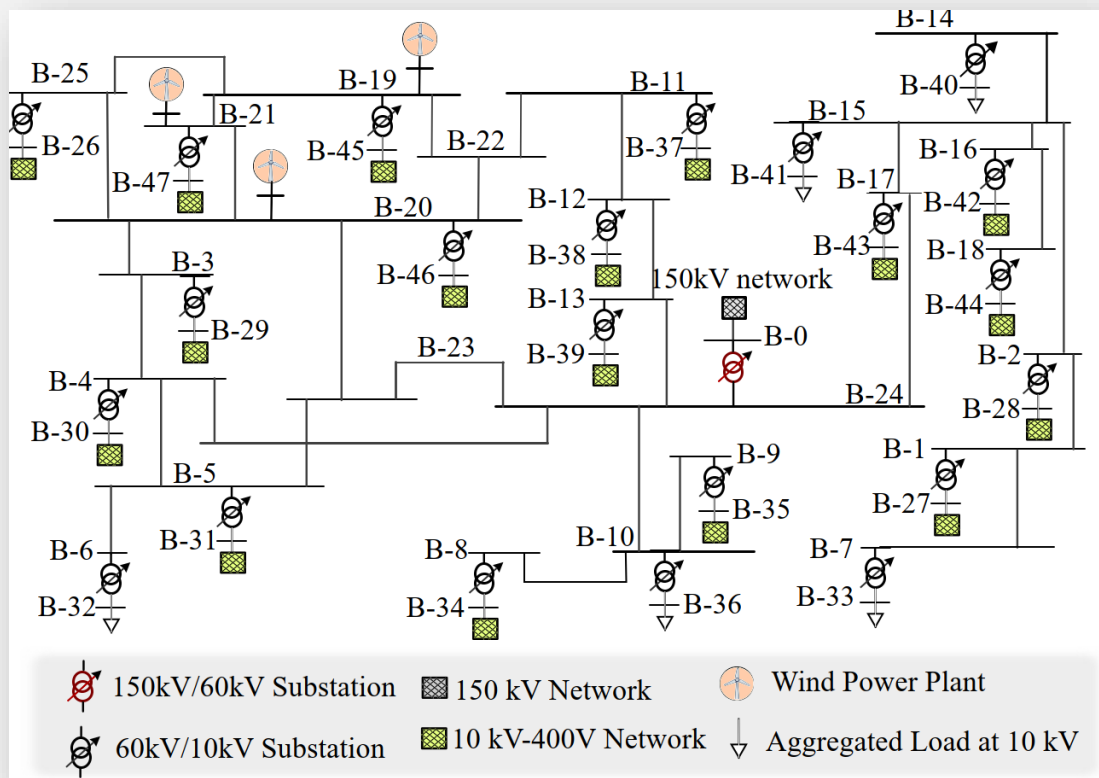
60kV Network
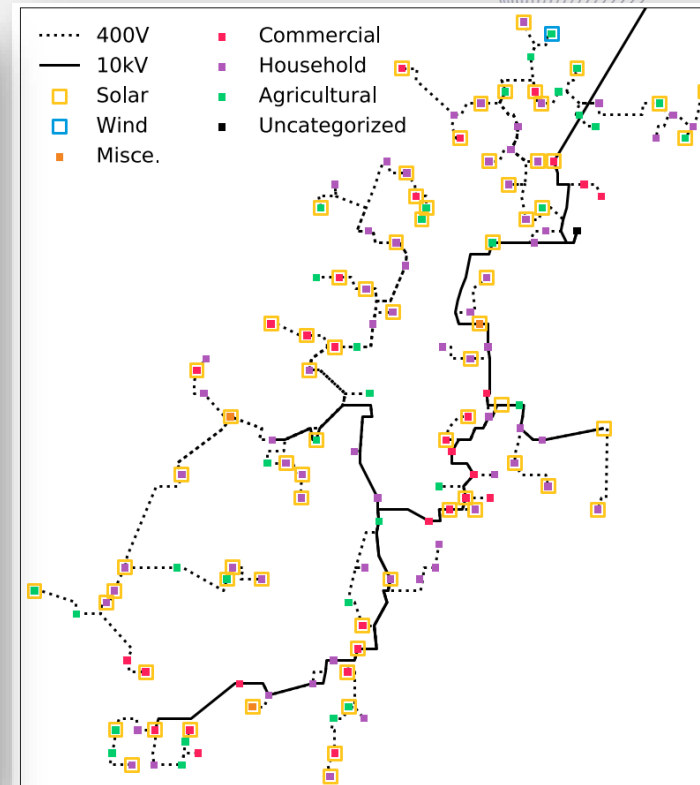
10kV-400V Network at Bus 27

- Minimum installed PV capacity: 1kW
- Minimum installed Wind capacity: 300kW
- PV plants installed at 400V and 10kV
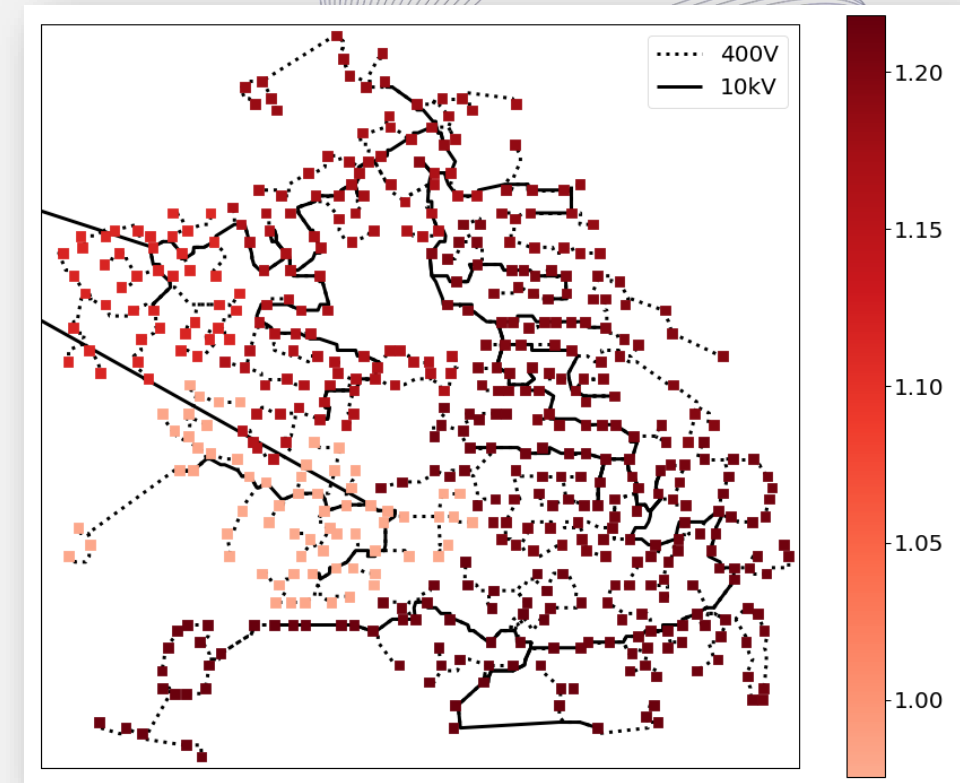- Wind power installed only at 10kV

Load flow result: Voltage profile in the network at Bus 46

1st Jan 2015 02:00

- Line Losses: 0.26 MW

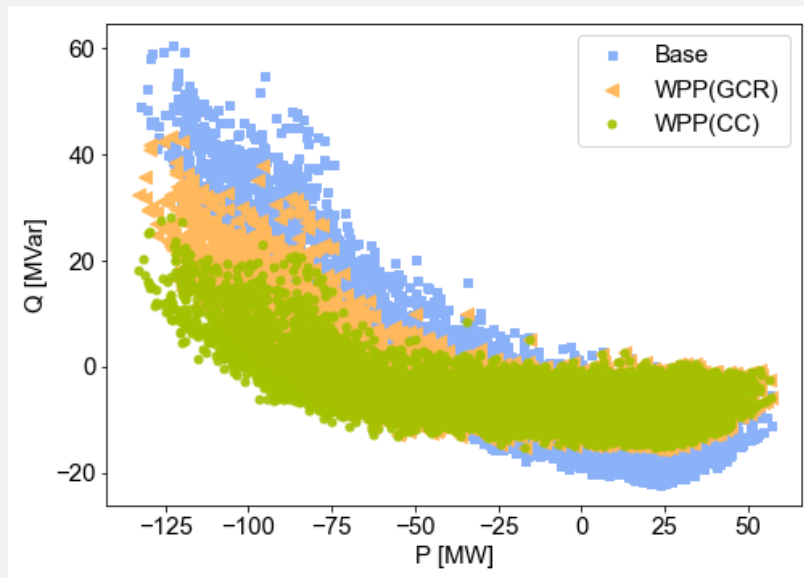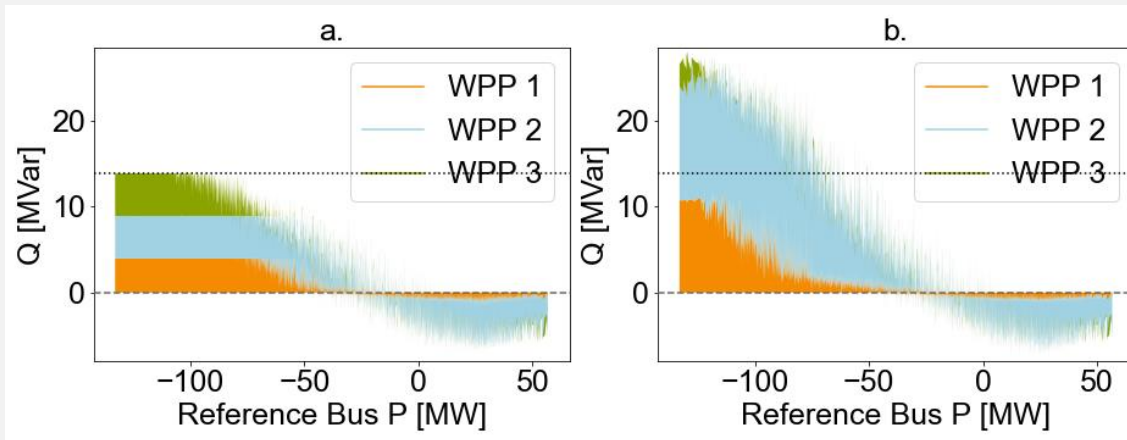- Demand at 60kV/10kV substation: 1.84 MW
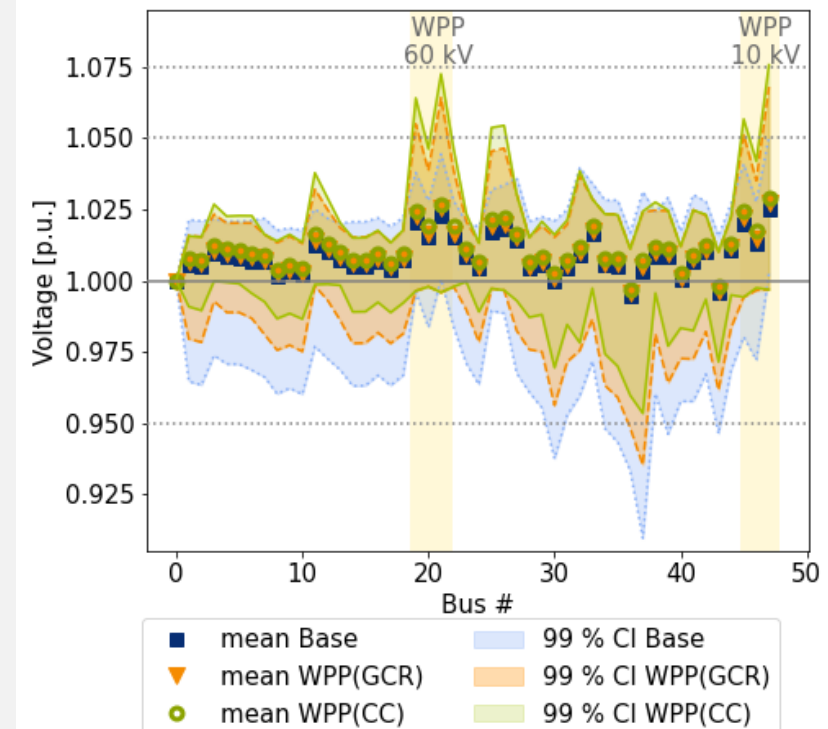
- Generation: 0.042

20th Dec 2014, 22:00

- Line Losses: 11.06 MW

- Demand at 60kV/10kV substation: -31 MW

- Generation: 32.62

Optimizing reactive power from WPPs in the 60kV network

TOTAL ENERGY LOSS AND LOSS REDUCTION IN ALL CASES

	Energy loss [MWh]	Δ Loss [MWh]	% Reduction -
Base Case	6742.2	0	0
WPP(GCR)	6487.2	255	3.8
WPP(CC)	6423.87	318.33	4.8

Thank you ☺

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