



WASHINGTON STATE
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Scalable Multi-Period Optimal Power Flow for Active Power Distribution Systems

or simply, Scalable MP-OPF in ADS

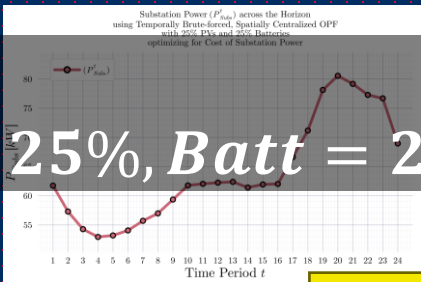
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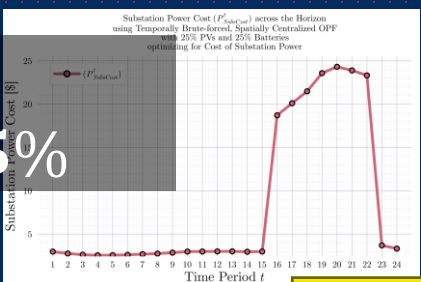
Washington State University

ADS10_1ph: MPCOPF Run for $T = 24, PV = 25\%, Batt = 25\%$

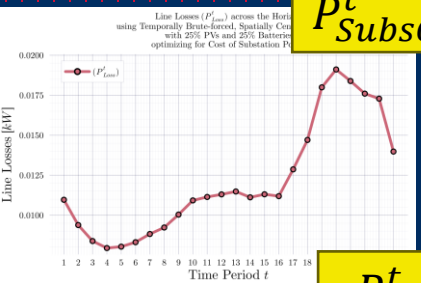
- 1. Machine ID: etrl309-aryan
- 2. Horizon Duration: 24
- 3. Nature of Simulation: Temporally Brute-forced, Spatially Centralized
- 4. Objective: Cost of Substation Power
- 5. GED Configuration: pv 25 batt 25
- 6. Maximum Substation Power Allowed: Inf kW



P_{Subs}^t



$P_{SubsCost}^t$



P_{Loss}^t

MPCOPF Simulation Results

- Full 24 Hour Horizon
- 7. Horizon Total Cost of Substation Power: \$ 204.74
- 8. Horizon Total Line Loss: 0.29 kW
- 9. Horizon Total Substation Power: 1537.94 kW + 512.25 kVar
- 10. Horizon Total Load: 1591.0 kW + 795.66 kVar
- 11. Horizon Total Generation: 53.35 kW + 283.88 kVar
- 12. Horizon Total Static Capacitor Reactive Power Generation: 0.0 kVar
- 13. Horizon Total Substation Power Cost: \$204.74
- 14. Horizon Total PV Generation: 55.22 kW + 174.87 kVar
- 15. Horizon Total Battery Generation: -1.87 kW + 109.0 kVar
- 16. Horizon Total Battery Transaction Magnitude: 36.44 kW + 109.0 kVar
- 17. Horizon Total SCD Observed: 0.0 kW
- 18. Horizon-end Battery Energy Deviation from Reference: 0.0 kWh
- 19. Horizon-Total All time Substation Power Peak: 80.56 kW
- 20. Number of Macro-Iterations: 1
- 21. Simulation Time: 0.84 s
- 22. Time to solve with sequential (non-parallel) computation: 0.84 s
- 23. Time to solve if OPF computation parallelized: 0.84 s

Objective

$P_{SubsPeak}$

Timings

OpenDSS Powerflow Results

- Full 24 Hour Horizon Validation Results
- 4. Horizon Total Substation Power Cost: \$204.74
- 5. Horizon Total Line Loss: 0.29 kW
- 6. Horizon Total Substation Power: 1537.94 kW + 510.56 kVar
- 7. Horizon Total Load: 1591.0 kW + 795.66 kVar
- 8. Horizon Total Generation: 53.35 kW + 283.88 kVar
- 9. Horizon Total Static Capacitor Reactive Power Generation: 0.0 kVar
- 10. Horizon Total PV Generation: 55.22 kW + 174.87 kVar
- 11. Horizon Total Battery Generation: -1.87 kW + 109.0 kVar
- 12. Horizon Total Battery Transaction Magnitude: 0.0 kW + 0.0 kVar
- 13. Horizon Total SCD Observed: N/A
- 14. Horizon-end Battery Energy Deviation from Reference: 0.0 kWh
- 15. Horizon-Total All Time Substation Power Peak: 80.56 kW

Objective

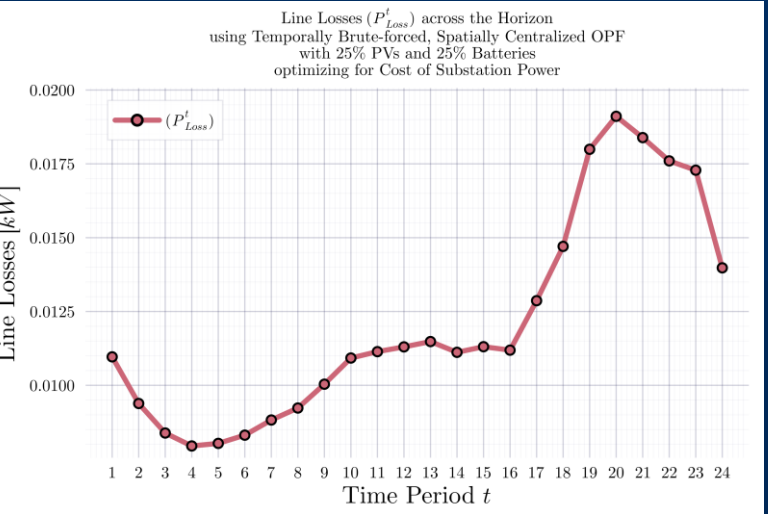
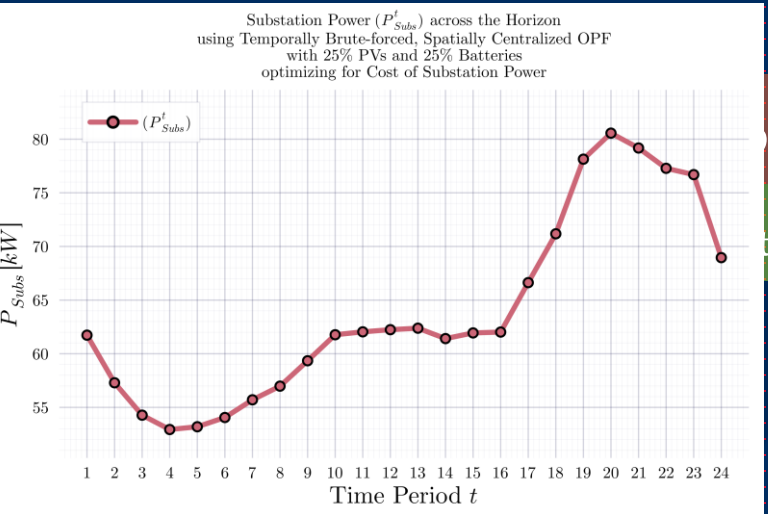
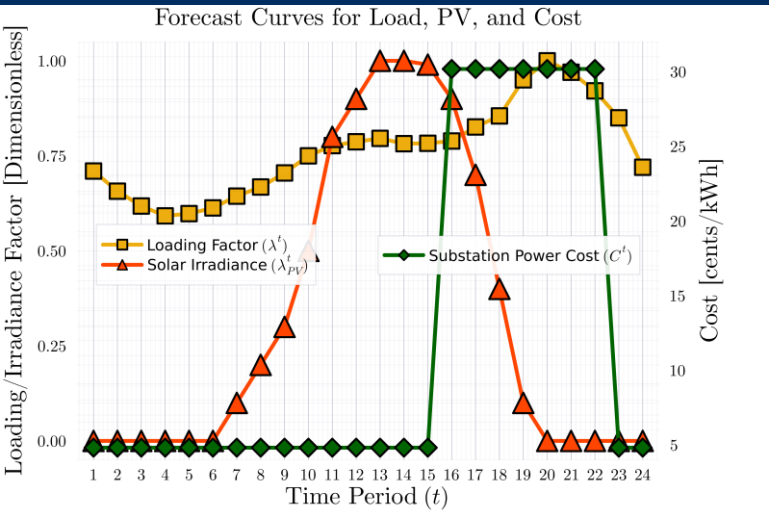
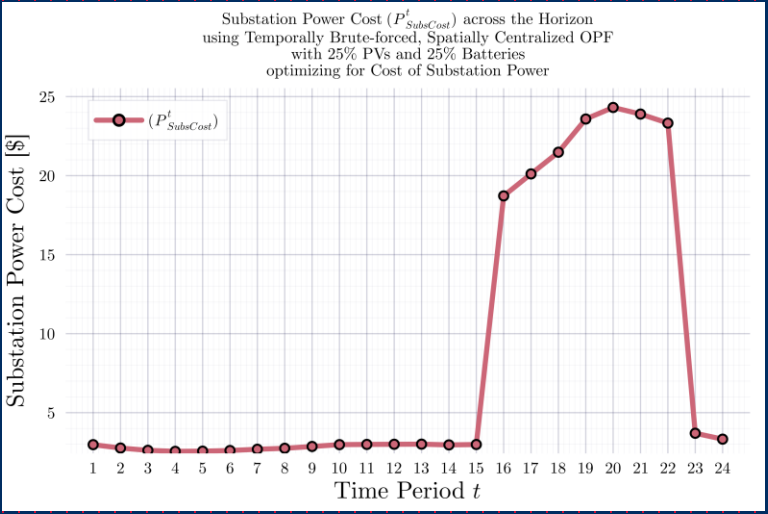
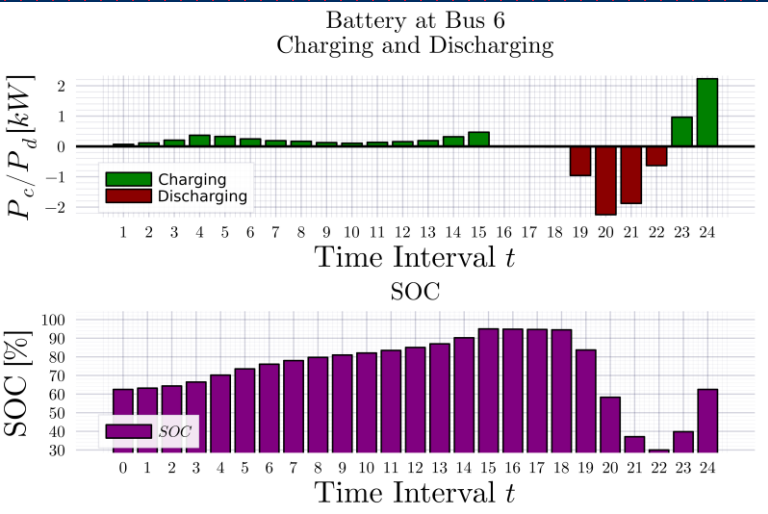
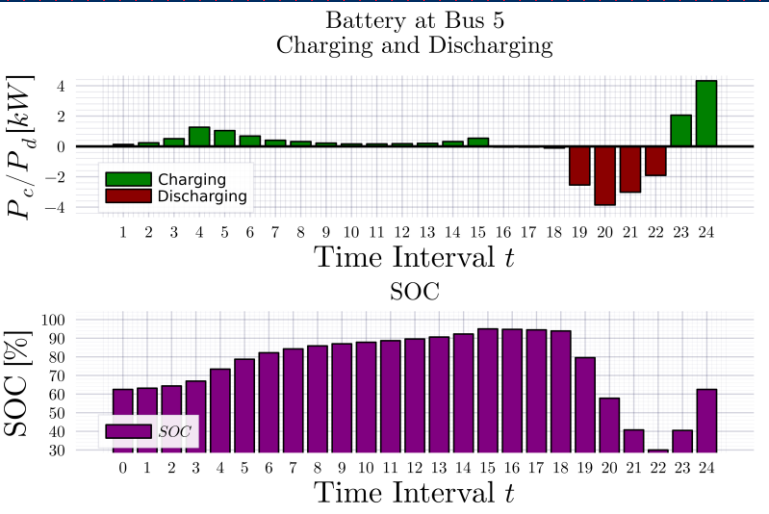
Miscomputation - will be fixed later

Discrepancies (Maximum All Time):

- 16. Maximum All Time Voltage Discrepancy: 0.000531 pu
- 17. Maximum All Time Line Loss Discrepancy: 1.0e-5 kW
- 18. Maximum All Time Substation Borrowed Real Power Discrepancy: 1.5e-5 kW
- 19. Maximum All Time Substation Borrowed Reactive Power Discrepancy: 0.070577 kVar

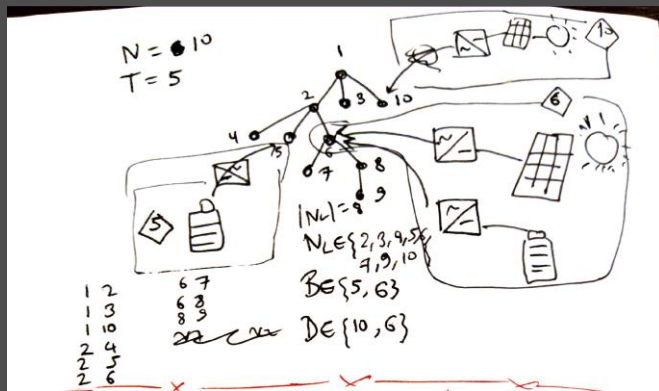
Discrepancies

ADS10_1ph: MPCOPF Run for $T = 24$, $PV = 25\%$, $Batt = 25\%$



Three Steps for Optimization Implementation (and what will be different for DDP):

1. [No change] Loading Simulation Configuration from OpenDSS (.dss) files, Pre-optimization housekeeping
2. [Some change] Optimization Routine (Temporally brute forced optimization now verified, can be used as 'Benchmark' result for checking Optimality Gap)
3. [No change] Post Optimization result validation via OpenDSSDirect



Now onto writing the script for DDP
optimization routine ..

Initial Test System: ADS10_1ph
with 8 Loads, 2 PVs and 2 Batteries