In the following subsections, the proposed algorithm is compared against the centralized (MPCOPF) algorithm in terms of resultant optimal control variables, optimality gap in objective function and computational performance. Secondly, the resultant control variables are tested for ACOPF feasiblity against OpenDSS. Section -A describes the comparison over a 5 time-period horizon with an additional focus on describing the workflow of the MPDOPF algorithm. Section -B describes the comparsion over a 10 time-period horizon to test for the scalability of the MPDOPF algorithm.

A. Simulation Results

Table I represents a cmoparsion between MPCOPF and MPDOPF in their problem scope, results and computational performance.

1) Biggest Subproblem vs Computational Performance: This first section of the table, 'Biggest subproblem' provides specifics of the 'computational bottleneck' encountered by either algorithm during its course. As established in **??**, the bottleneck represents the OPF subproblem which is computationally the most intensive, and thus is a key indicator of the expected time the algorithm will take to complete.

TABLE I: Comparative analyses between MPCOPF and MPDOPF - 5 time-period horizon

Metric	**MPCOPF**	**MPDOPF**
Biggest subproblem		
Decision variables	3150	1320
Linear constraints	5831	2451
Nonlinear constraints	635	265
Simulation results		
Substation power cost ($)	576.31	576.30
Substation real power (kW)	4308.28	4308.14
Line loss (kW)	75.99	76.12
Substation reactive power (kVAR)	574.18	656.24
PV reactive power (kVAR)	116.92	160.64
Battery reactive power (kVAR)	202.73	76.01
Computation		
Number of Iterations	-	5
Total Simulation Time (s)	521.25	49.87

Further, here the

TABLE II: ACOPF feasibility analyses - 5 time-period horizon

Metric	**MPDOPF**	**OpenDSS**
Full horizon		
Substation real power (kW)	4308.14	4308.35
Line loss (kW)	76.12	76.09
Substation reactive power (kVAR)	656.24	652.49
Max. all-time discrepancy		
Voltage (pu)	0.0002	
Line loss (kW)	0.0139	
Substation power (kW)	0.3431	

Boundary Variable Plots are too tall, make them slightly shorter, like 25% of the page only.

B. Scalability Analysis

To demonstrate the effectiveness of the proposed algorithm over a bigger horizon to demonstrate scalability, simulations were run for a 10 time-period horizon. Figure 4 shows

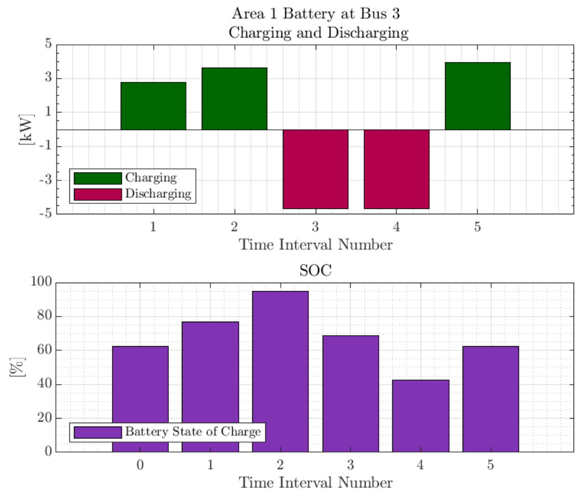


Fig. 1: Charging-Discharging and SOC graphs for Battery at Bus 3 located in Area 1 obtained by MPDOPF

the forecasted profiles for load, solar irradiance and cost of substation power over the horizon.

1) Comparison between MPCOPF and MPDOPF: In this section, comparative analyses are carried out between MPCOPF and MPDOPF considering 10-hour time steps with 20% PV penetration and 30% battery penetration.

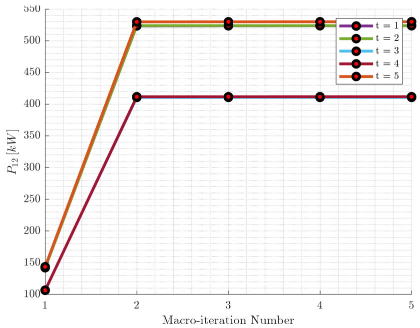
TABLE III: Comparative analyses between MPCOPF and MPDOPF - 10 time-period horizon

Metric	**MPCOPF**	**MPDOPF**
Biggest subproblem		
Decision variables	6300	2640
Linear constraints	11636	4891
Nonlinear constraints	1270	530
Simulation results		
Substation power cost ($)	1197.87	1197.87
Substation real power (kW)	8544.28	8544.04
Line loss (kW)	148.67	148.94
Substation reactive power (kVAR)	1092.39	1252.03
PV reactive power (kVAR)	222.59	139.81
Battery reactive power (kVAR)	388.52	310.94
Computation		
Number of Iterations	-	5
Total Simulation Time (s)	4620.73	358.69

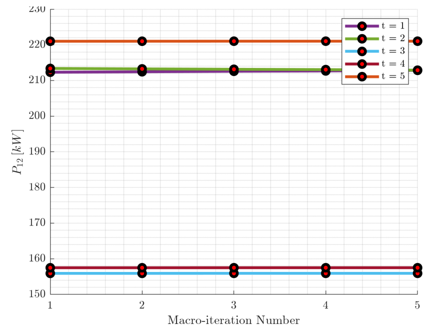
Further, here the

TABLE IV: ACOPF feasibility analyses - 10 time-period horizon

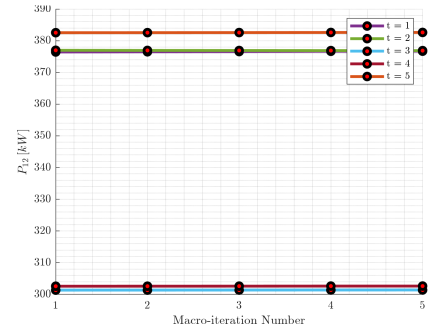
Metric	**MPDOPF**	**OpenDSS**
Full horizon		
Substation real power (kW)	8544.04	8544.40
Line loss (kW)	148.94	148.87
Substation reactive power (kVAR)	1252.03	1243.36
Max. all-time discrepancy		
Voltage (pu)	0.0002	
Line loss (kW)	0.0132	
Substation power (kW)	0.4002	



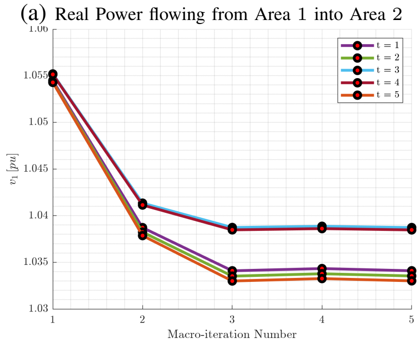
(a) Real Power flowing from Area 1 into Area 2



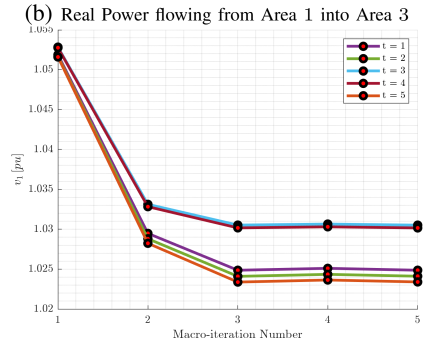
(b) Real Power flowing from Area 1 into Area 3



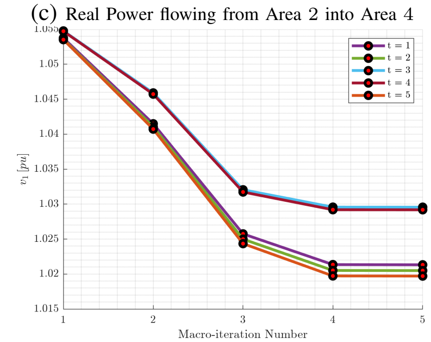
(c) Real Power flowing from Area 2 into Area 4



(d) Voltage at the PoI of Area 1 and Area 2



(e) Voltage at the PoI of Area 1 and Area 3



(f) Voltage at the PoI of Area 2 and Area 4

Fig. 2: Convergence of Boundary variables with every iteration. Each plot represents a particular variable exchanged between a pair of connected areas. Each line graph within a plot represents a particular time period.

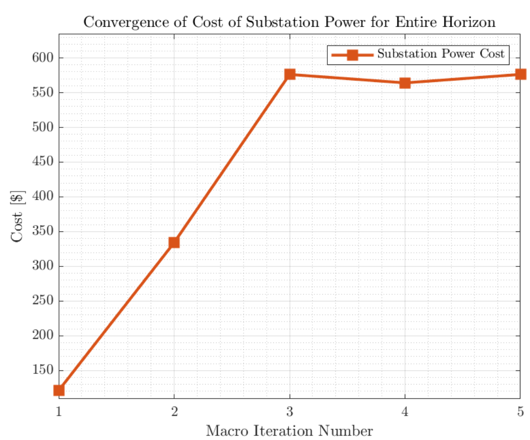


Fig. 3: Convergence of Objective Function Value with each MPDOPF iteration

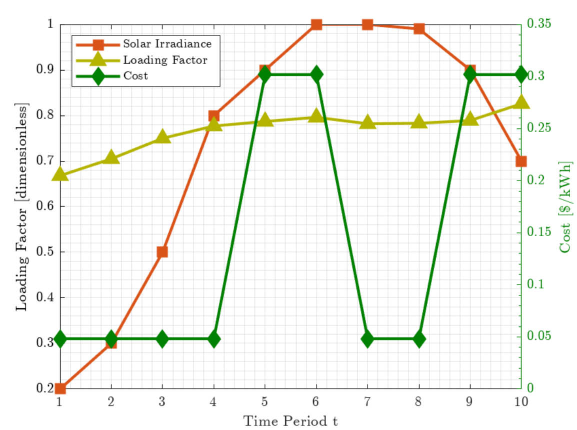


Fig. 4: Forecasts for Demand Power, Irradiance and Cost of Substation Power over a 10 Hour Horizon

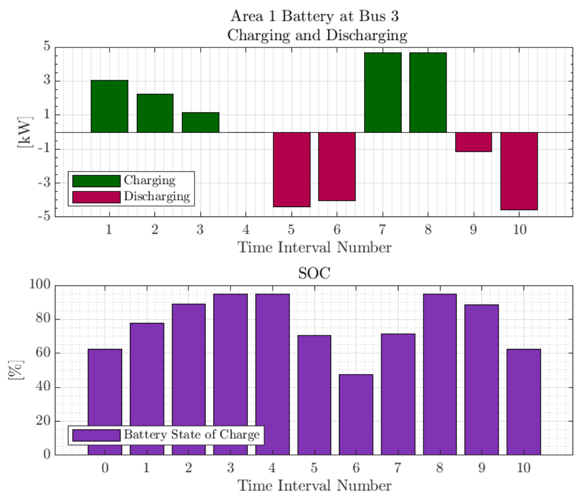


Fig. 5: Charging-Discharging and SOC graphs for Battery at Bus 3 located in Area 1 obtained via MPDOPF