



WASHINGTON STATE
UNIVERSITY

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

or simply, Scalable MP-OPF in ADS

Aryan Ritwajeet Jha

Graduate Research Assistant

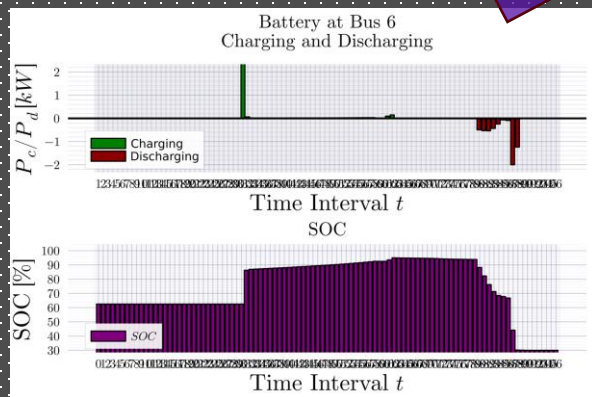
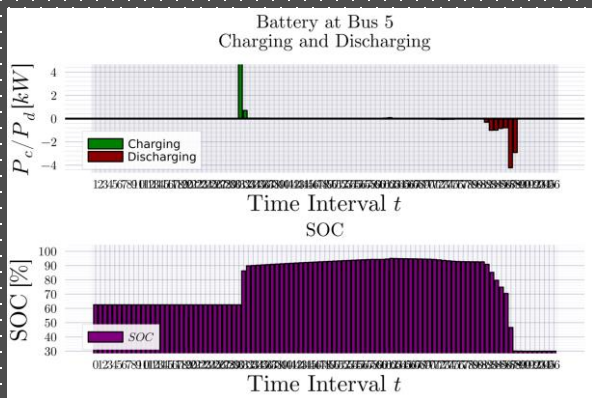
Washington State University

$ADS10_{1ph}$
 $T = 96$

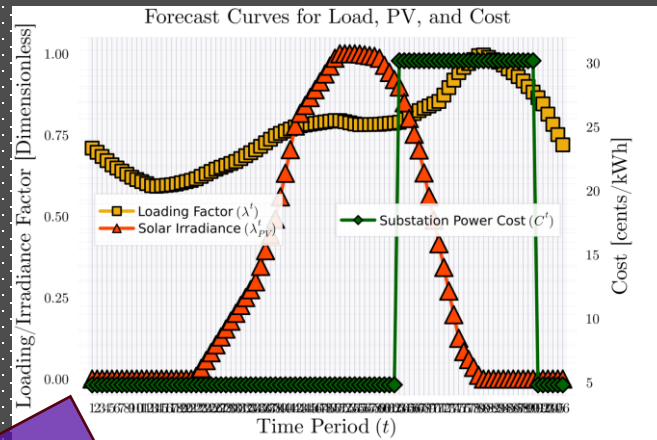
DDP Trajectory vs #Forward Passes [k]

Terminal SOC Constraint Relaxed

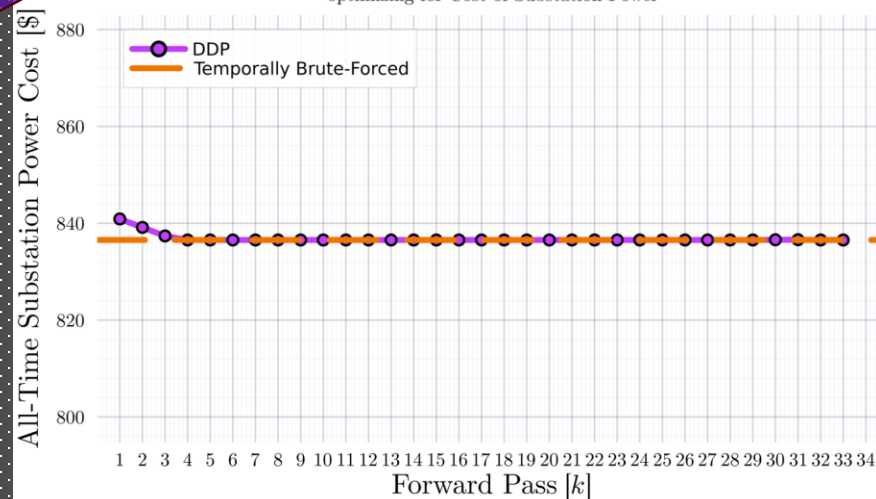
DDP



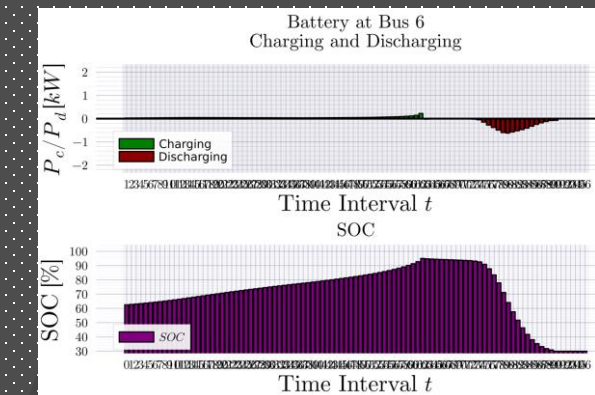
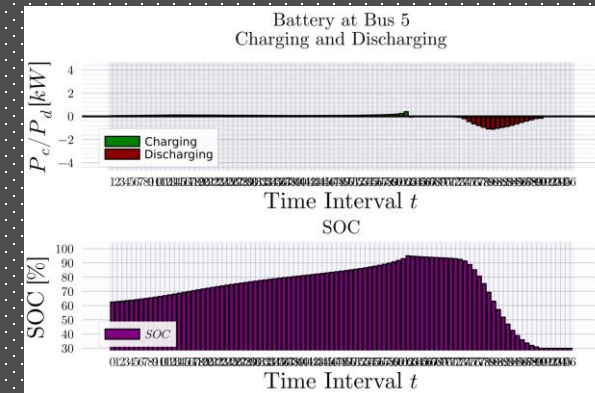
$k_{Max} = 33$



All-Time Substation Power Cost ($P_{SubstCost}^{allT}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 25% PVs and 25% Batteries optimizing for Cost of Substation Power



BruteForced (BF)



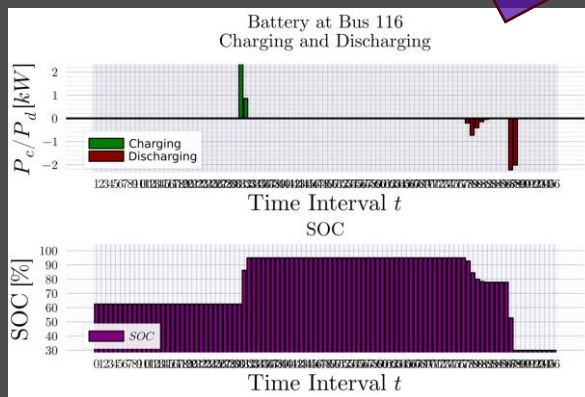
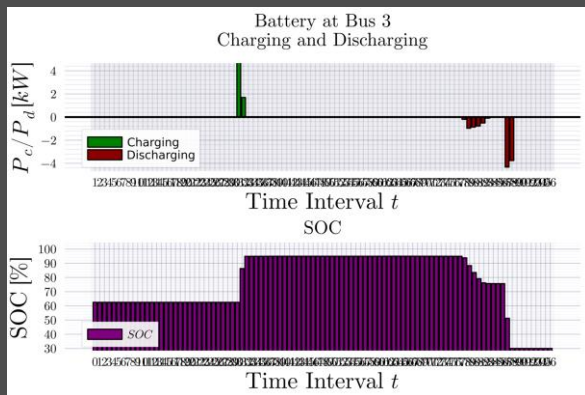
Looks 'successful'

IEEE123_{1ph},
 $T = 96$

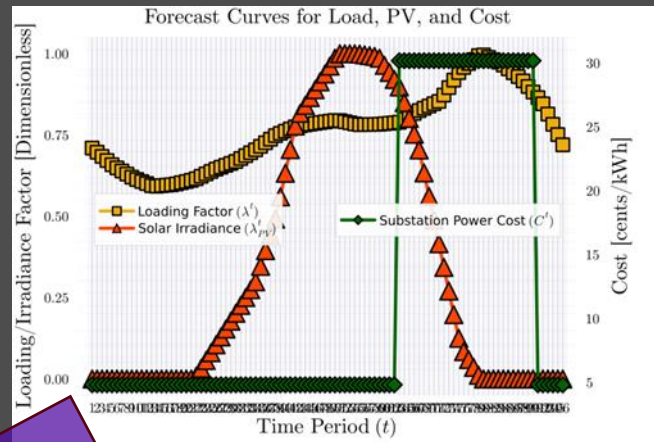
DDP Trajectory vs #Forward Passes [k]

Terminal SOC Constraint Relaxed

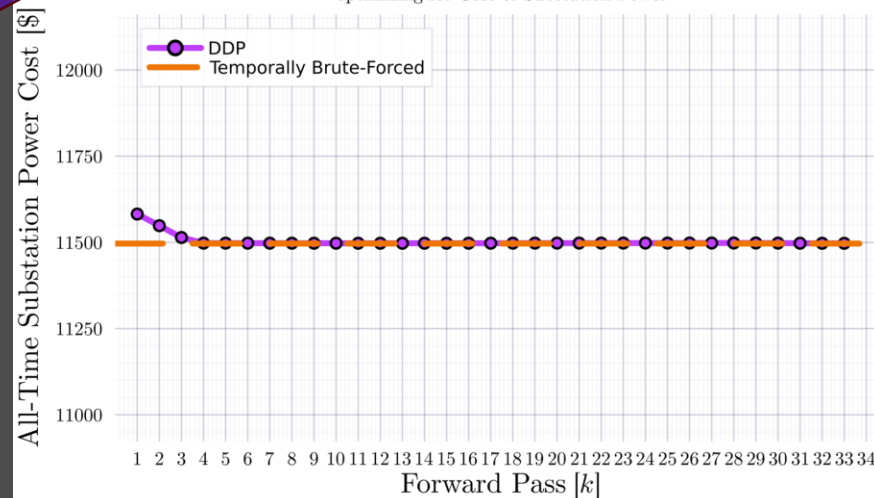
DDP



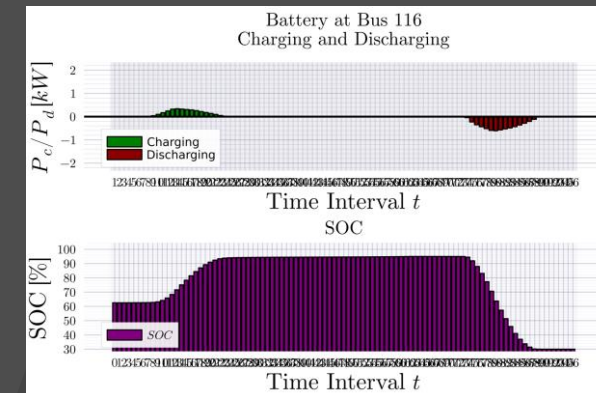
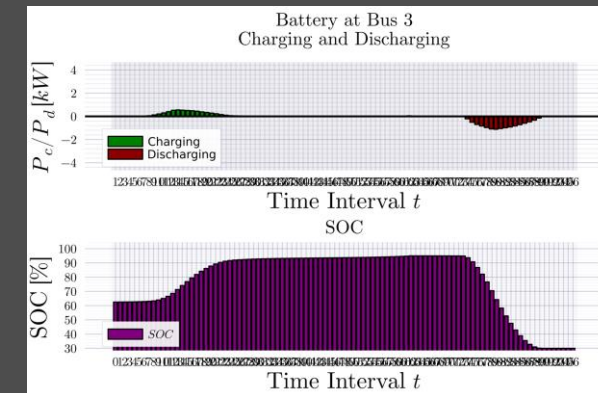
$k_{Max} = 33$



All-Time Substation Power Cost ($P_{SubCost}^{allT}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 20% PVs and 31% Batteries optimizing for Cost of Substation Power



BruteForced (BF)

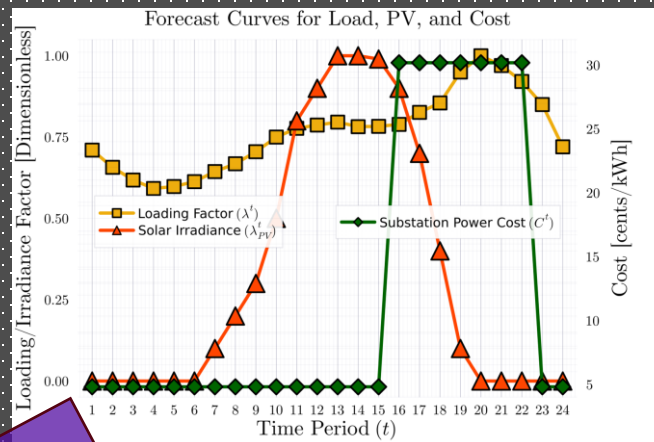
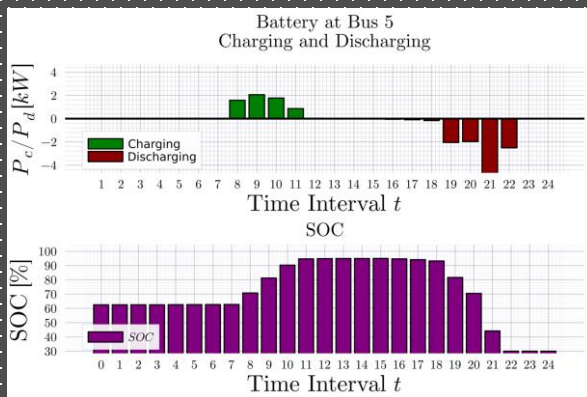


$ADS10_{1ph}$
 $T = 24$

DDP Trajectory vs #Forward Passes [k]

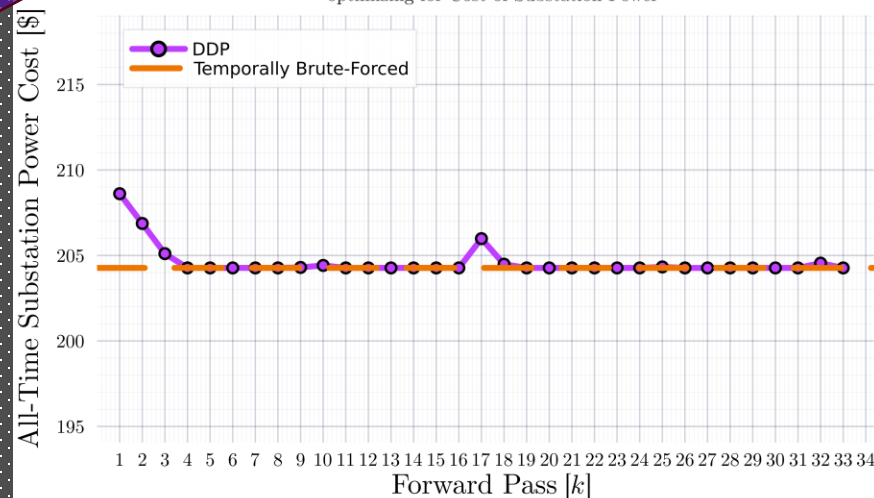
Terminal SOC Constraint Relaxed

DDP

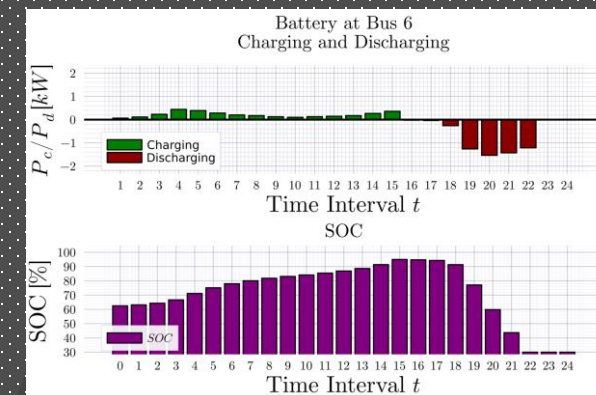
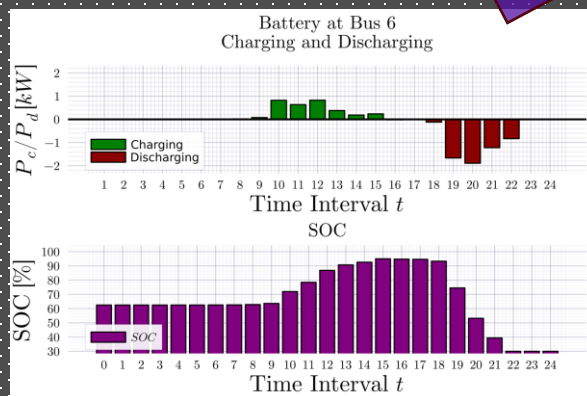
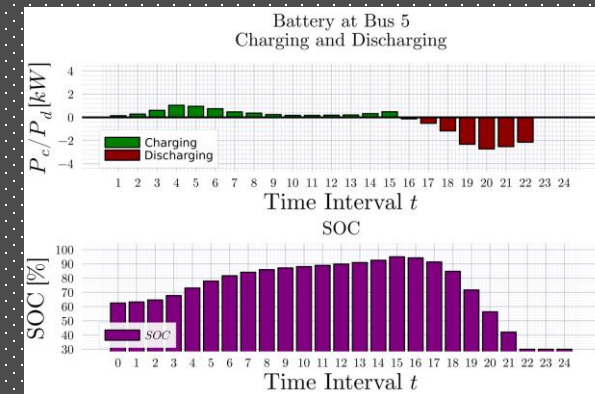


Looks 'successful'

All-Time Substation Power Cost ($P_{SubCost}^{allT}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 25% PVs and 25% Batteries optimizing for Cost of Substation Power



BruteForced (BF)



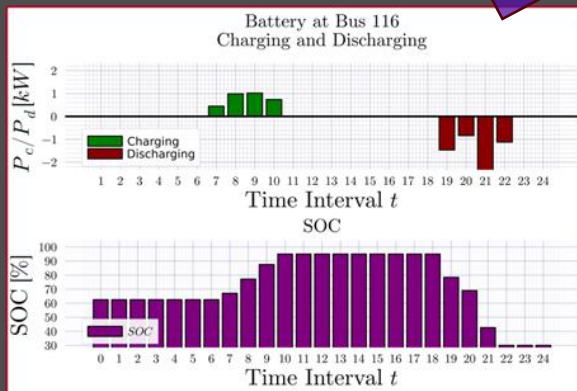
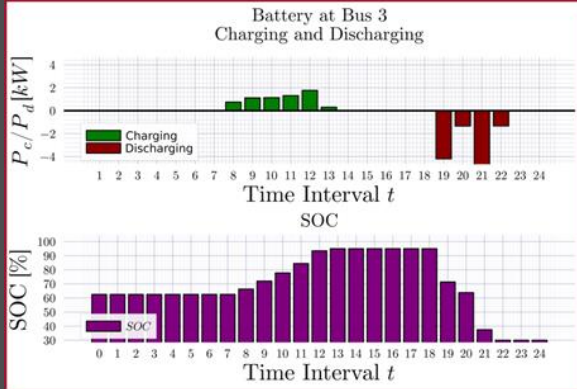
$k_{Max} = 33$

IEEE123_{1ph},
T = 24

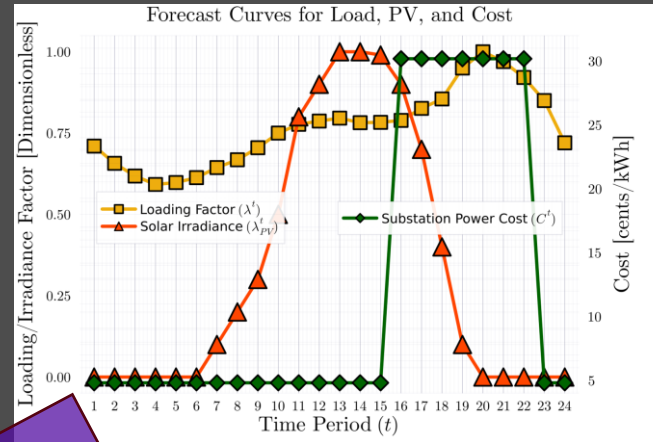
DDP Trajectory vs #Forward Passes [k]

Terminal SOC Constraint Relaxed

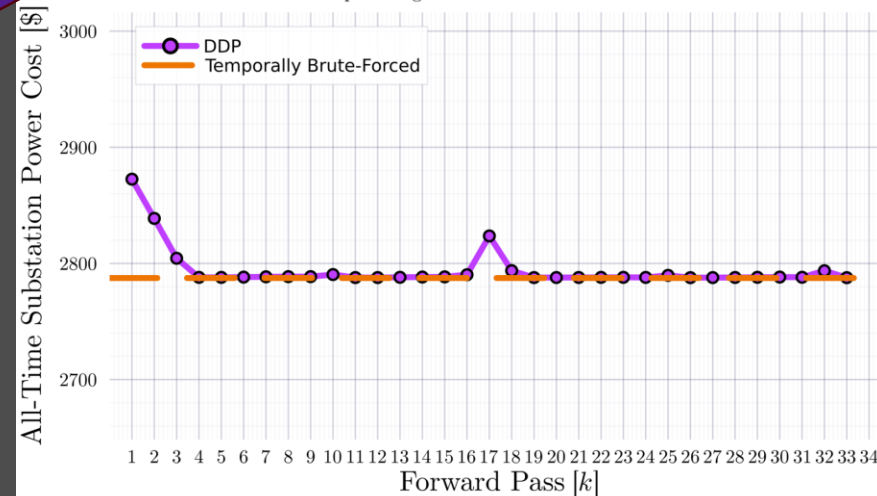
DDP



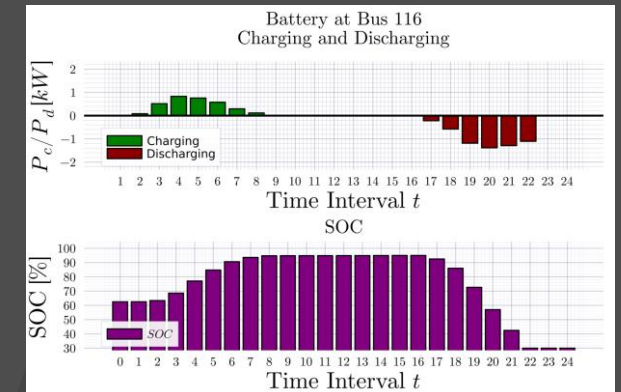
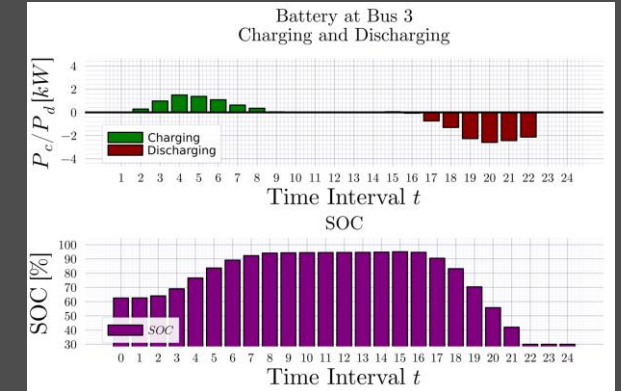
$k_{Max} = 33$



All-Time Substation Power Cost ($P_{SubCost}^{allT}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 20% PVs and 31% Batteries optimizing for Cost of Substation Power



BruteForced (BF)

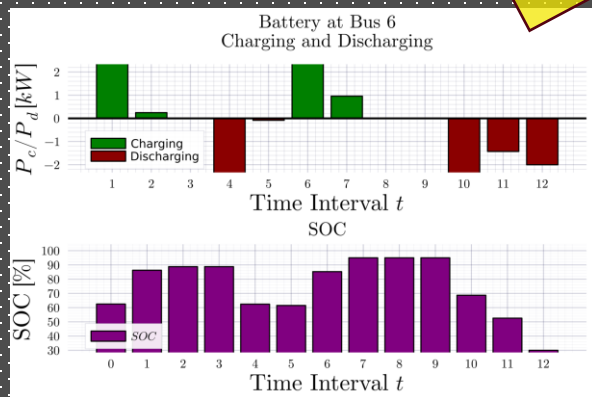
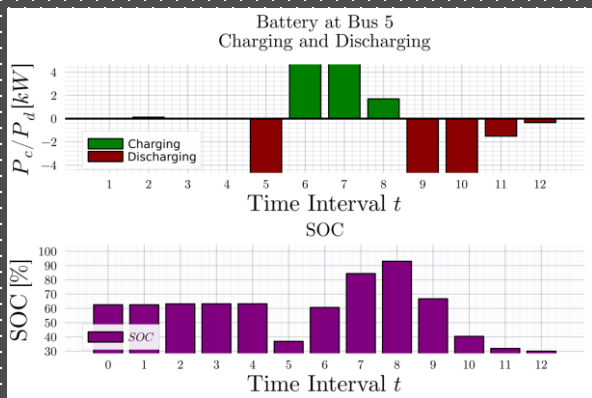


$ADS10_{1ph}$
 $T = 12$

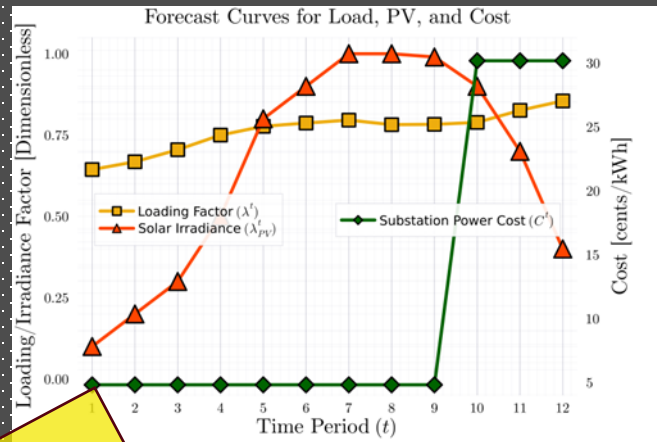
DDP Trajectory vs #Forward Passes [k]

Terminal SOC Constraint Relaxed

DDP

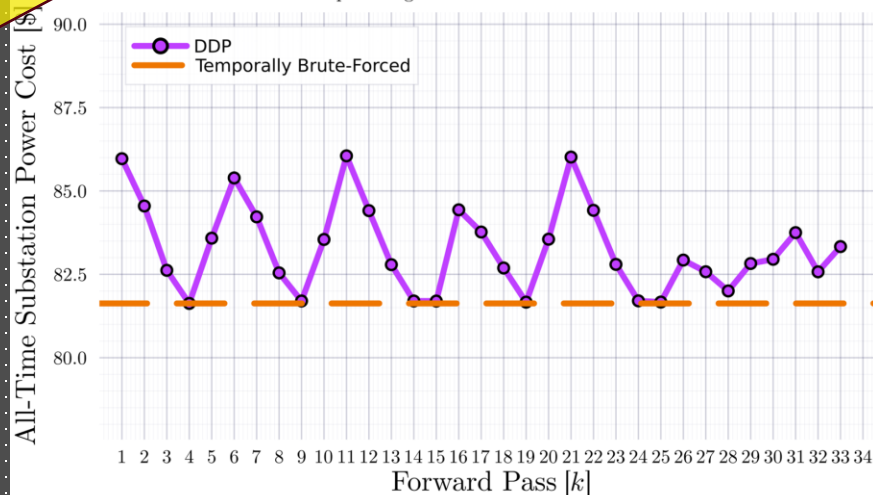


$k_{Max} = 33$



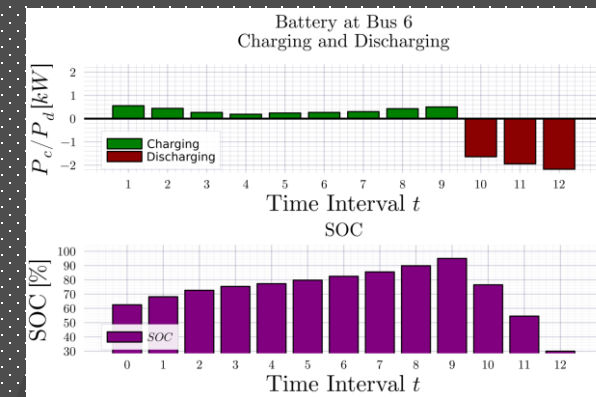
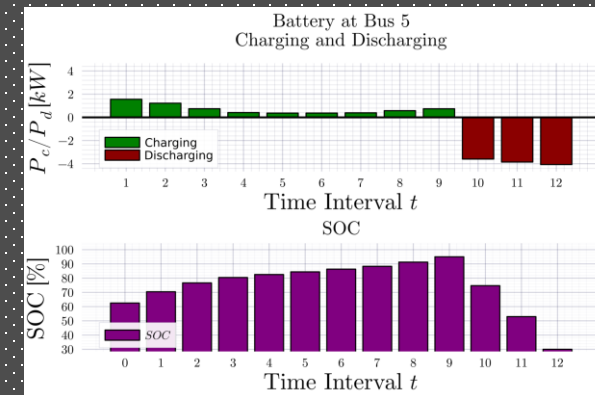
Will NOT converge

All-Time Substation Power Cost ($P_{SubCost}^{all}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 25% PVs and 25% Batteries optimizing for Cost of Substation Power



Even if not converging, it at least does 'hit' the optimal value periodically.

BruteForced (BF)

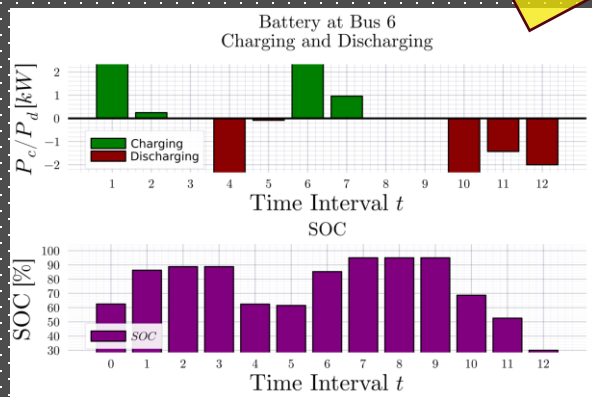
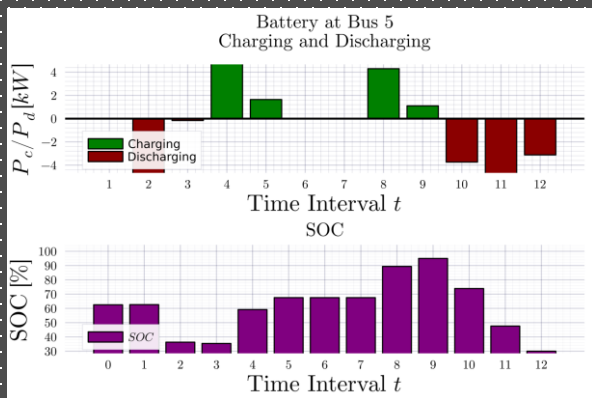


$ADS10_{1ph}$
 $T = 12$

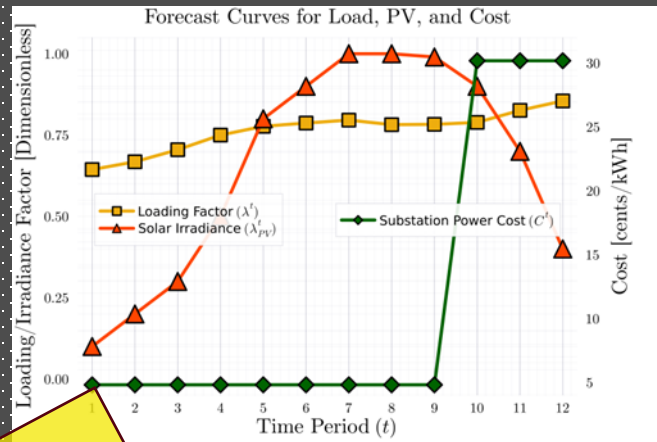
DDP Trajectory vs #Forward Passes [k]

Terminal SOC Constraint Relaxed

DDP

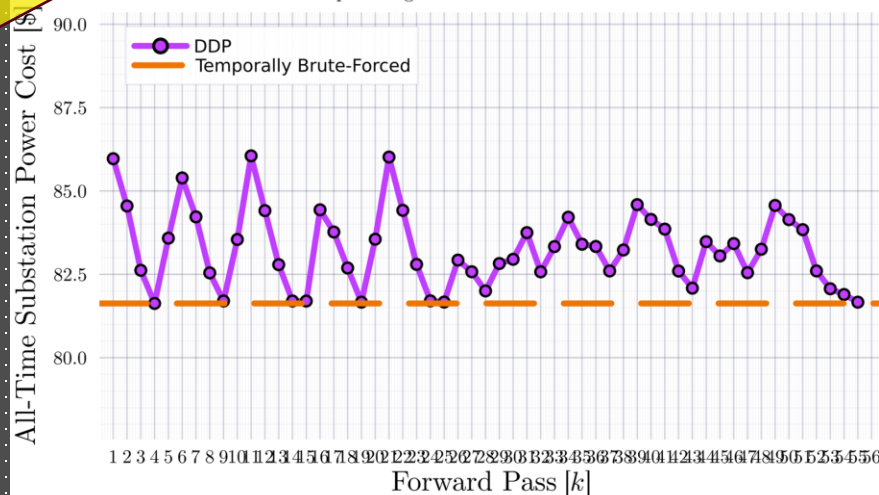


$k_{Max} = 55$



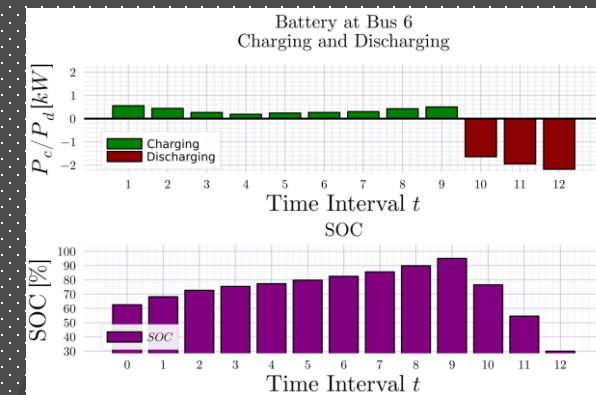
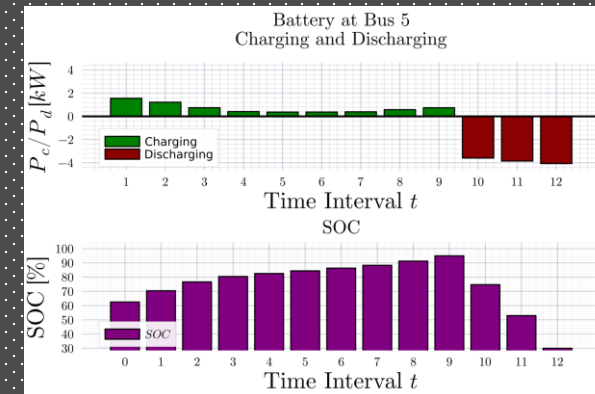
Will NOT converge

All-Time Substation Power Cost ($P_{SubstCost}^{allT}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 25% PVs and 25% Batteries optimizing for Cost of Substation Power



Even if not converging, it at least does 'hit' the optimal value periodically.

BruteForced (BF)

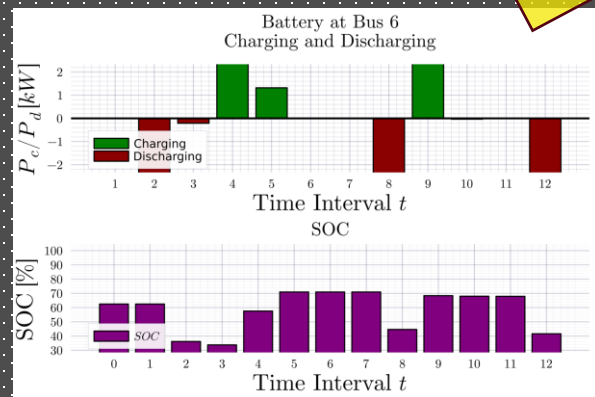
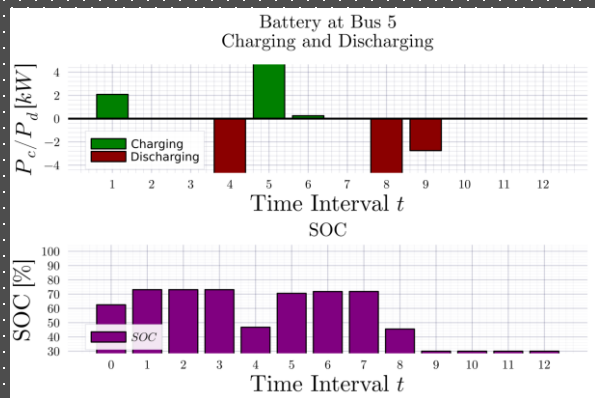


$ADS10_{1ph}$
 $T = 12$

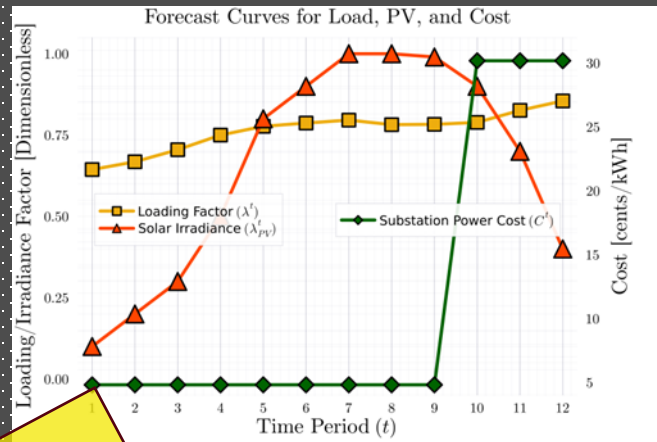
DDP Trajectory vs #Forward Passes [k]

Terminal SOC Constraint Relaxed

DDP

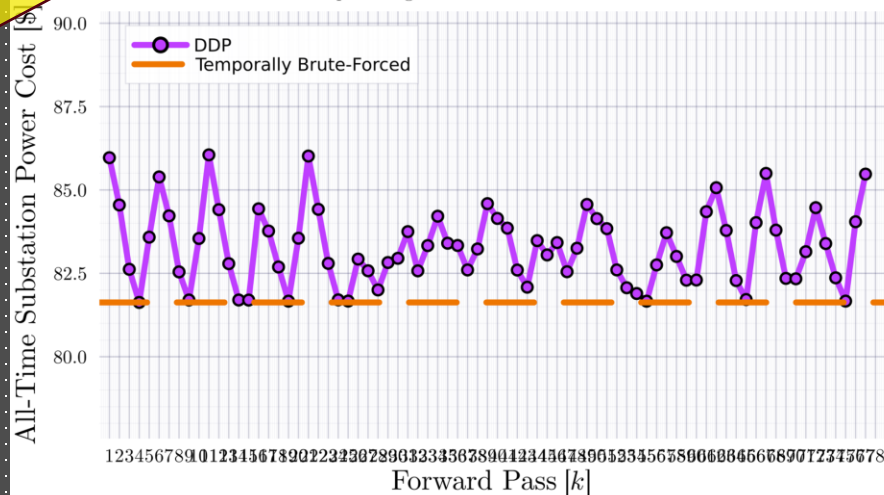


$k_{Max} = 77$

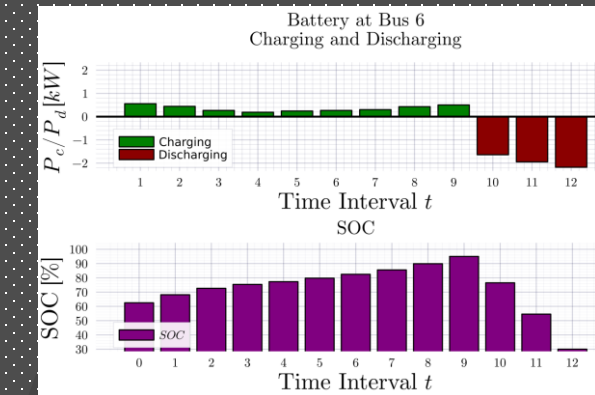
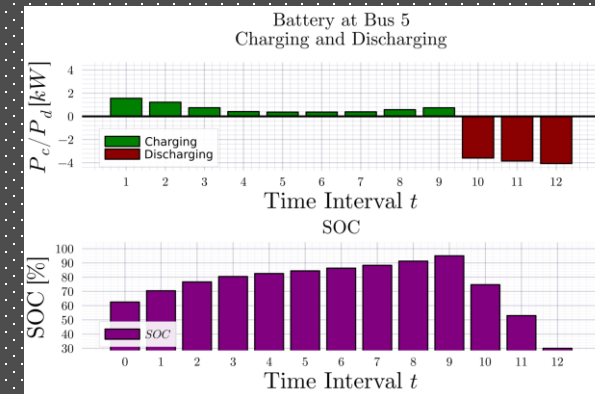


Will NOT converge

All-Time Substation Power Cost ($P_{SubCost}^{allT}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 25% PVs and 25% Batteries optimizing for Cost of Substation Power



BruteForced (BF)



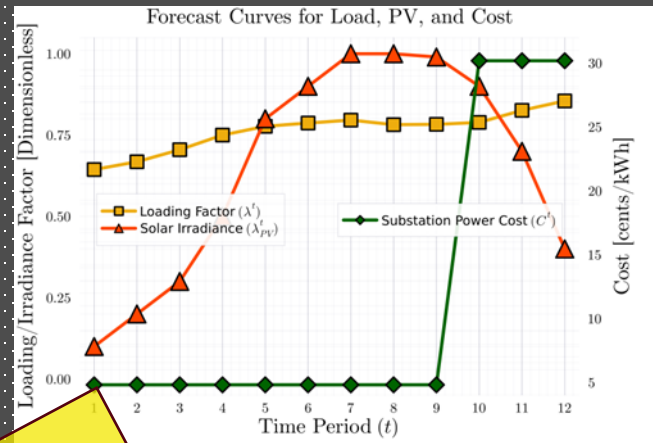
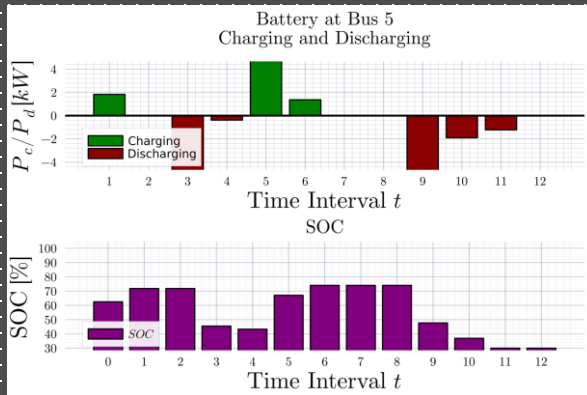
Even if not converging, it at least does 'hit' the optimal value periodically.

$ADS10_{1ph}$
 $T = 12$

DDP Trajectory vs #Forward Passes [k]

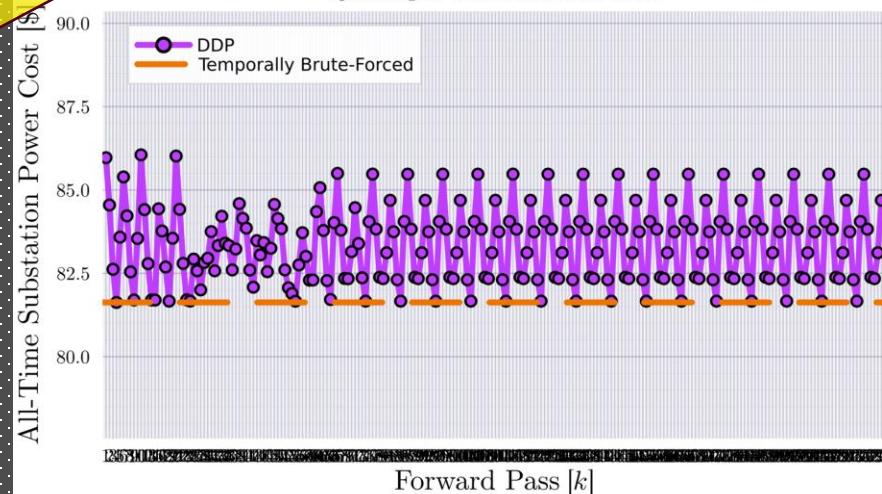
Terminal SOC Constraint Relaxed

DDP

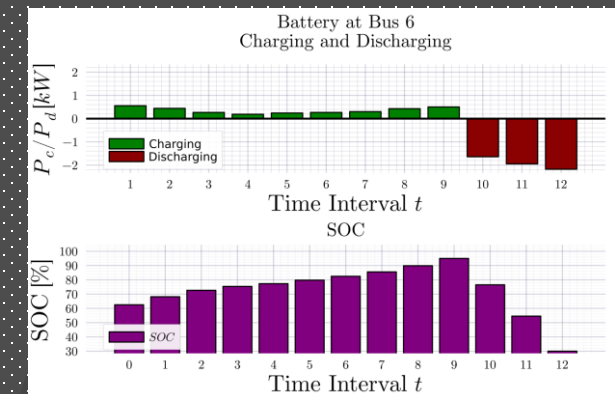
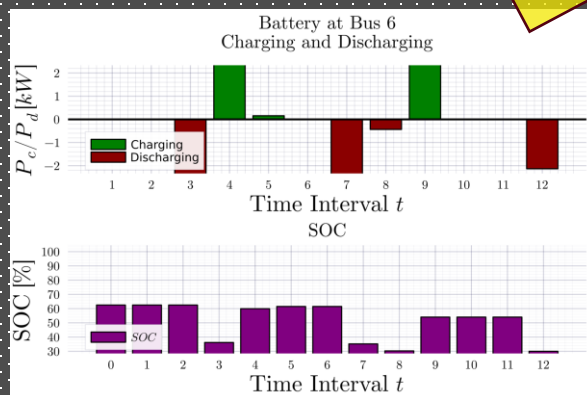
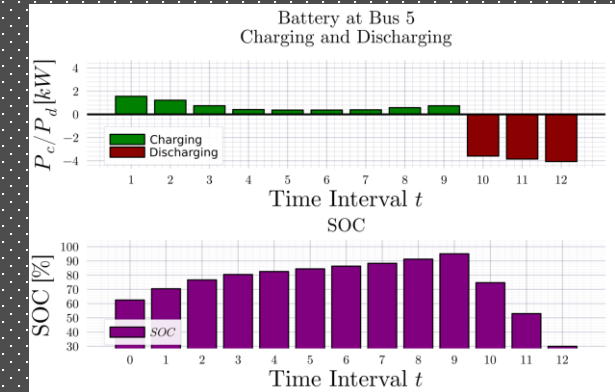


Will NOT converge

All-Time Substation Power Cost ($P_{SubCost}^{all}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 25% PVs and 25% Batteries optimizing for Cost of Substation Power



BruteForced (BF)



$k_{Max} = 222$

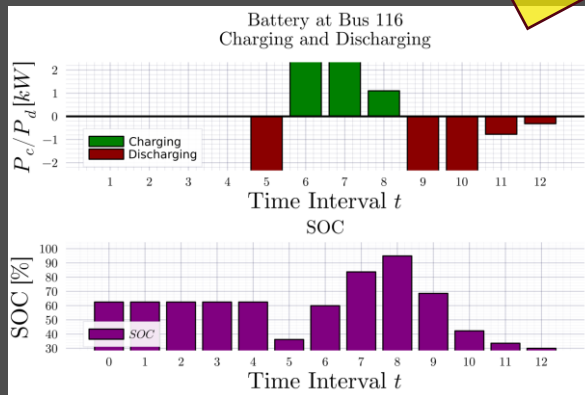
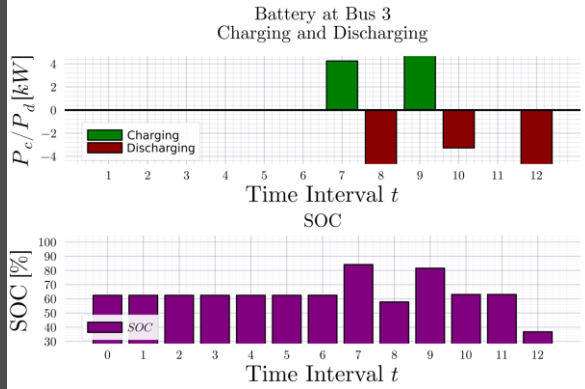
Even if not converging, it at least does 'hit' the optimal value periodically.

IEEE123_{1ph},
T = 12

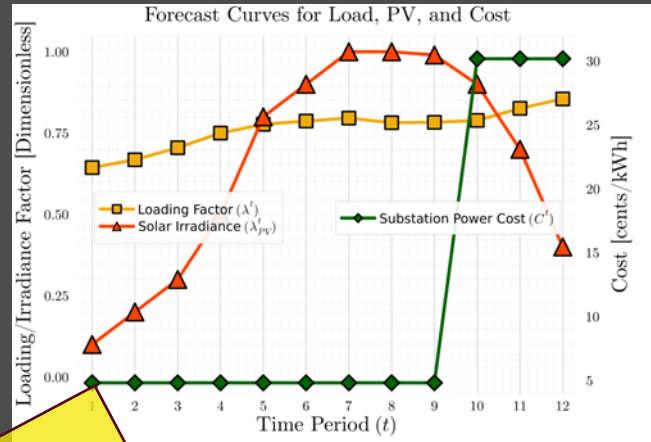
DDP Trajectory vs #Forward Passes [k]

Terminal SOC Constraint Relaxed

DDP

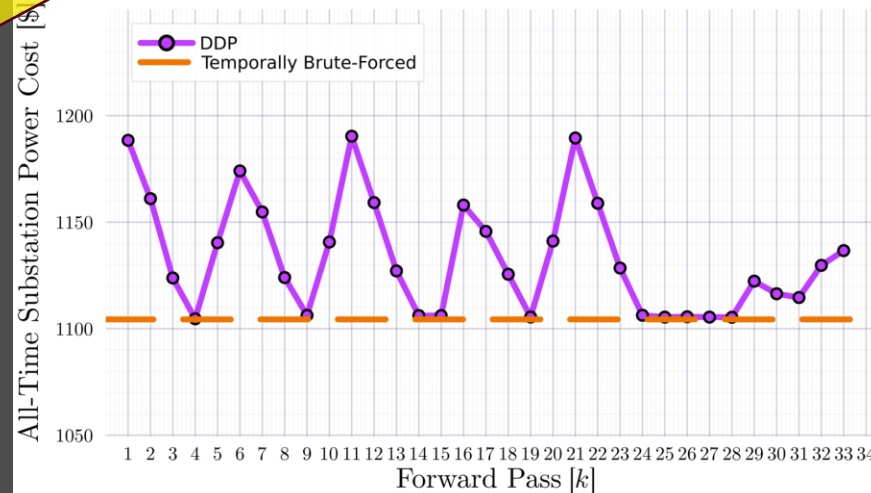


$k_{Max} = 33$



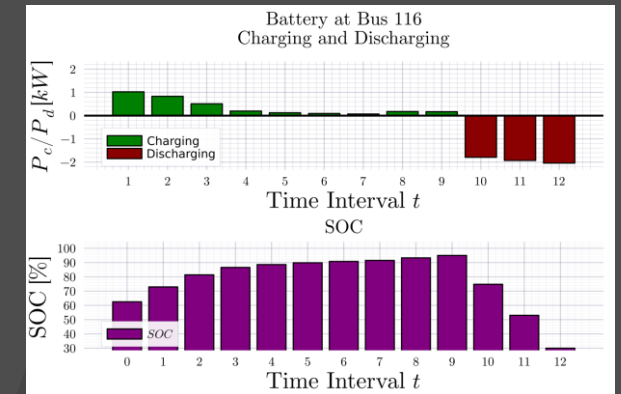
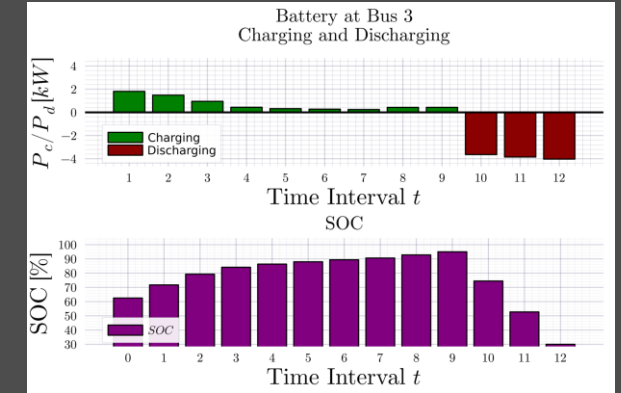
Will NOT converge

All-Time Substation Power Cost ($P_{SubCost}^{all}$) across Forward Passes using Temporally Decomposed via DDP, Spatially Centralized OPF with 20% PVs and 31% Batteries optimizing for Cost of Substation Power



Even if not converging, it at least does 'hit' the optimal value periodically.

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