Supplementary Material for " A Differentially Private Reconfiguration Approach for Multi-Agent Distribution Networkss"

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I. Algorithmic Pseudo-code

We will exhibit the algorithmic pseudo-code for this proposed C-ADMM-based DP-DNR mechanism $\widetilde{\mathcal{M}}$ with a random perpetuation vector $\boldsymbol{\xi}^l$. As stated previously, the output of $\widetilde{\mathcal{M}}$ can be a mixture of obfuscated-but-feasible tie-line load flows $\boldsymbol{x}^{l_t^*}$ and realistically optimal topology solution $\boldsymbol{u}^{l*}$ of the entire ADNs. The maximum iteration number is set to k_{max}, and then we can summarize this algorithm as below.

Algorithm 1 C-ADMM-based DP-DNR Mechanism $\widetilde{\mathcal{M}}$

Initialization with input $\boldsymbol{c}$, $\boldsymbol{A}$, $\boldsymbol{G}_v$, $\boldsymbol{G}_{cr}$, $\boldsymbol{b}_v$, $\boldsymbol{b}_{cr}$, $\boldsymbol{b}_u$, $\boldsymbol{K}$, $\boldsymbol{h}$ over $n_{\mathcal{A}}$ agents and input parameters ε, ϑ, Δ_ρ, τ, $\overline{\boldsymbol{g}}$, $\overline{\boldsymbol{\alpha}}^l$;
Sample a random perturbation vector $\boldsymbol{\xi}^l$, i.i.d. $\boldsymbol{\xi}^l \sim \mathbb{P}_\xi$;
while $k \leqslant k_{max}$ **do**
  Each agent distributively updates $(\boldsymbol{X}_{i,b}^{k+1}, \boldsymbol{V}_{i,b}^{k+1}) \leftarrow (\boldsymbol{Z}_x^k, \boldsymbol{W}_v^k)$ by (9a) and sends $(\boldsymbol{X}_{i,b}^{k+1}, \boldsymbol{V}_{i,b}^{k+1})$ to the DSO;
  DSO updates $(\boldsymbol{Z}_x^{k+1}, \boldsymbol{W}_v^{k+1}) \leftarrow (\boldsymbol{X}_i^{k+1}, \boldsymbol{V}_{i,b}^{k+1})$ by (9b) and sends $(\boldsymbol{Z}_x^{k+1}, \boldsymbol{W}_v^{k+1})$ to all agents;
  Each agent distributively updates $(\boldsymbol{\mu}_{i,b}^{k+1}, \boldsymbol{\gamma}_{i,b}^{k+1}) \leftarrow (\boldsymbol{\mu}_{i,b}^{k}, \boldsymbol{\gamma}_{i,b}^{k})$ by (9c) and $\mathcal{V}_i(\boldsymbol{W}_v^k) \leftarrow \mathcal{V}_i(\boldsymbol{W}_v^{k+1})$;
  if convergence condition is satisfied **then**
    return optimal solution $(\boldsymbol{X}^*, \boldsymbol{u}^{l*})$ for the entire ADNs;
  else
    $k \leftarrow k+1$;
  end if
end while
Release both obfuscated-but-feasible $\boldsymbol{x}^{l_t^*}$ and realistically optimal topology variables $\boldsymbol{u}^{l_t^*}$ for $\forall l_t \in \mathcal{T}$.