1. Descriptions of Day-ahead and Real-time Energy Dispatch Problems

We firstly give the detailed form of the day-ahead operation problem. Let $x_{1,d,\tau}, x_{2,d,\tau}$ denote the power generation of DG1 and DG2, where $\boldsymbol{x}_{d,\tau} = [x_{1,d,\tau}, x_{2,d,\tau}]$. Let $\bar{x}_i, \forall i \in \{1,2\}$ be the power capacity of those two DGs. The day-ahead operation problem is given by

$$\min_{\{x_{1,d,\tau}\}_{\tau=1}^{T}, \{x_{2,d,\tau}\}_{\tau=1}^{T}} \quad \sum_{\tau=1}^{T}\sum_{i=1}^{2} \rho_i \cdot x_{i,d,\tau} \tag{1a}$$

$$\text{s.t.} \quad 0 \le x_{i,d,\tau} \le \bar{x}_i, \forall i \in \{1,2\}, \forall \tau = 1, ..., T \tag{1b}$$

$$-r_i \le x_{i,d,\tau+1} - x_{i,d,\tau} \le r_i, \forall i \in \{1,2\}, \forall \tau = 1, ..., T-1 \tag{1c}$$

$$x_{1,d,\tau} + x_{2,d,\tau} + \hat{y}_{d,\tau} = l_{d,\tau}, \forall \tau = 1, ..., T, \tag{1d}$$

where (1b) gives the constraint of maximum output power of DGs, (1c) gives the ramping constraints of DGs and (1d) gives the power balance constraint.

For the real-time operation problem, let $\tilde{z}^{+}_{i,d,\tau}, \forall i \in 1,2$ denote the power outputs for addressing energy deficit where $\tilde{\boldsymbol{z}}^{+}_{d,\tau} = [\tilde{z}^{+}_{1,d,\tau}, \tilde{z}^{+}_{2,d,\tau}]^{\top}$, and $\tilde{z}^{-}_{1,d,\tau}$ denote the absorbed power for addressing energy surplus. Let ρ_i^{+}, ρ_i^{-} denote the marginal cost and utility. With the objective of minimizing the operation cost, the real-time operation problem is

$$\{\min_{\tilde{\boldsymbol{z}}^{+}_{d,\tau}, \tilde{\boldsymbol{z}}^{-}_{1,d,\tau}} \quad -\rho_1^{-}\tilde{z}^{-}_{1,d,\tau} + \sum_{i=1}^{2}\rho_i^{+}\tilde{z}^{+}_{i,d,\tau} \tag{2a}$$

$$\text{s.t.} \quad 0 \le z^{-}_{1,d,\tau} \le \bar{z}_1^{-} \tag{2b}$$

$$0 \le z^{+}_{i,d,\tau} \le \bar{z}_i^{+}, \forall i \in \{1,2\} \tag{2c}$$

$$-z^{-}_{1,d,\tau} + \sum_{i=1}^{2} z^{+}_{i,d,\tau} + y_{d,\tau} - \hat{y}_{d,\tau} = 0\}, \forall \tau = 1, ..., T, \tag{2d}$$

where (2b) and (2c) are the constraints regarding the output limits. Eq. (2d) ensures that the deviation is settled by the outputs of flexible resources. The values of parameters in (1) and (2) are shown in Table 1, and Table 2.

Table 1: Costs and technical data of day-ahead operation

	$\overline{x}_i$ (kW)	ρ_i $(\$/kW)$	r_i (kW)
DG_1	70	30	50
DG_2	70	40	50

Table 2: Marginal cost/utility and technical data of real-time operation

$\rho_1^-/\$/\text{kW}$	$\rho_1^+/\$/\text{kW}$	$\rho_2^+/\$/\text{kW}$	$\bar{z}_1^-/\text{kW}$	$\bar{z}_1^+/\text{kW}$	$\bar{z}_2^+/\text{kW}$
20	100	200	30	10	30