Simulation-Based Optimization of Highway Active Traffic Management Strategy Designs-Appendix

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1 Overview of the proposed SBO method

The overviwe of the proposed SBO method is shown in Figure 1.

2 Pseudocode for CTM

The pseudocode for CTM is shown in Algorithm 1

Algorithm 1 Cell Transmission Model

For each time step $k \in K$:
  Compute mainline inlet flow $\phi_{0,k}$ via Equation (18).
  For each mainline cell $j \in J$:
    If $j = 1$ **and** $k = 1$, **then** compute density $\rho_{j,k}$ via Equation (20).
    Else if $k < j$, **then** compute density $\rho_{j,k}$ via Equation (21).
    Compute jam density $\rho^{\text{jam}}_{j,k}$, critical density $\rho^{\text{cri}}_{j,k}$, and capacity $q^{\text{cap}}_{j,k}$ via Equations (14)-(16).
  End for
  For each mainline cell $j \in J$:
    If $j \in J^*$, **then** compute mainline outflow $\phi^m_{j,k}$ via Equation (10).
    Else, compute mainline outflow $\phi^m_{j,k}$ via Equation (11).
  End for
  For each on-ramp $g \in G$:
    If $k = 1$, **then**
      Compute queue length $l_{g,k}$ via Equation (19).
      Compute on-ramp outflow $\phi^r_{g,k}$ via Equation (13).
    End if
    If $k \in K^*$, **then** compute queue length $l_{g,k+1}$ via Equation (12).
  End for
  For each mainline cell $j \in J$:
    If $k \in K^*$, **then** compute density $\rho_{j,k+1}$ via Equation (9).
  End for

3 Pseudocode for AHA sampling

The pseudocode for CTM is shown in Algorithm 2

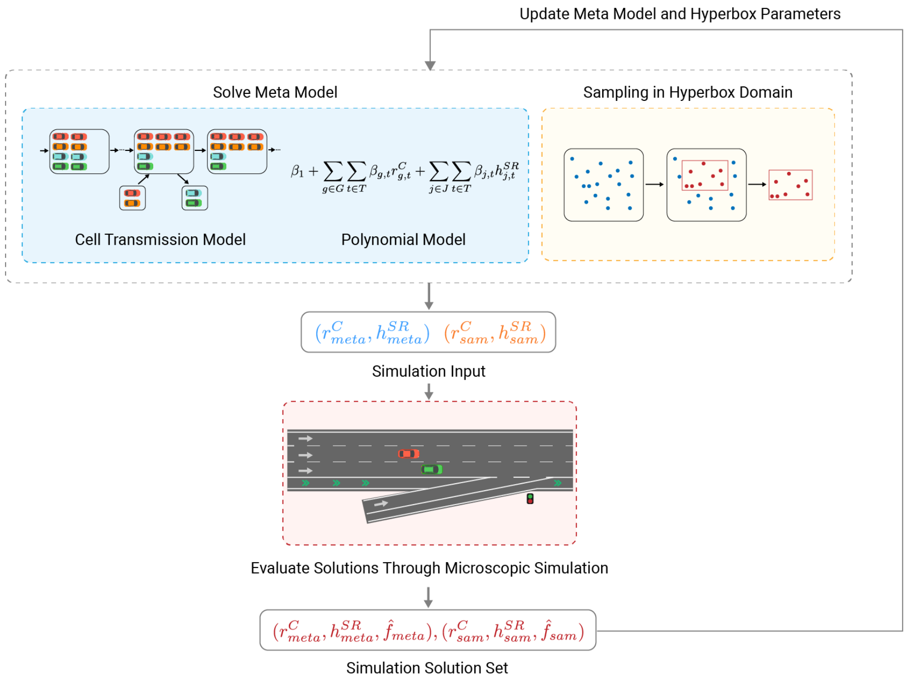

Figure 1: Overview of the SBO technique for determining the highway management strategies.

Algorithm 2 AHA sampling

Initialization:
Set iteration steps $u = 0$.
Set hyperbox parameters for on-ramp in-merge rates $\mathcal{H}_u^{RC} = \{0.15 \leq r^c_{g,t} \leq 1, \forall g \in G, \forall t \in T\}$.
Set hyperbox parameters for shoulder lane states $\mathcal{H}_u^{HSR} = \{h^{SR}_{g,t} \in \{0,1\}, \forall g \in G, \forall t \in T\}$.
Step 1: Sampling
Uniformly sample within the hyperbox domain defined by Equations 43-44 to obtain ω solutions:

$$(\mathbf{r}^c_{sam,1,u}, \mathbf{h}^{SR}_{sam,1,u}), \ldots, (\mathbf{r}^c_{sam,\omega,u}, \mathbf{h}^{SR}_{sam,\omega,u}).$$

Step 2: Simulation
Evaluate $(\mathbf{r}^c_{sam,1,u}, \mathbf{h}^{SR}_{sam,1,u}), \ldots, (\mathbf{r}^c_{sam,\omega,u}, \mathbf{h}^{SR}_{sam,\omega,u})$ through microscopic simulations to obtain delays:

$$\hat{f}_{sam,1,u}, \ldots, \hat{f}_{sam,\omega,u}.$$

Update simulation solution sets through Equations 38 and 42.
Step 3: Updating hyperbox parameters
Update hyperbox parameters through Equations 43-44.
Update iteration step $u = u + 1$.
Return to Step 1.