

Building Agent-Based Models of Seaport Container Terminals

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11 May 2010

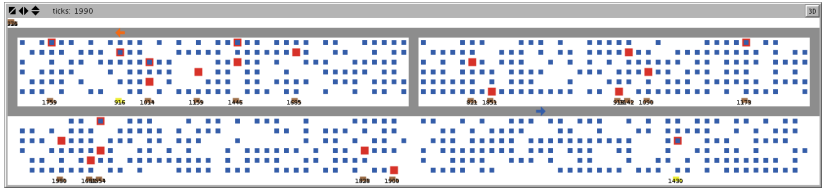








Model



Model

- ▶ Each crane c picks the truck t that maximizes its utility u_c :

$$t^* \leftarrow \arg_{t \in T} \max u_c(t).$$

- ▶ That becomes its goal g_c

$$g_c \leftarrow \begin{cases} t^* & \text{if } u_c(t^*) > u_c(g_c) + \textit{decomit-penalty} \\ g_c & \text{otherwise,} \end{cases}$$

distance-based utility

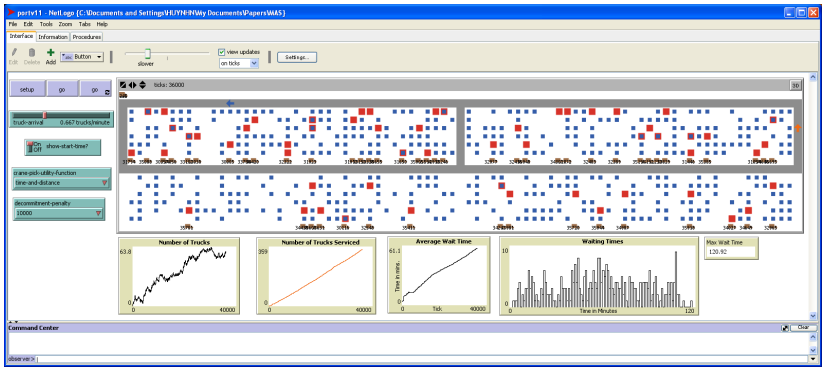
$$\begin{aligned} u_c^{\text{distance}}(t) = & -\text{DISTANCE}(\text{PATH}(c, t)) \\ & - p_1 \cdot \text{OTHER-CRANE?}(\text{PATH}(c, t)) \\ & - p_2 \cdot \text{HAS-TURN?}(\text{PATH}(c, t)) \\ & - p_3 \cdot \text{CHANGE-HEADING?}(\text{PATH}(c, t)) \\ & - p_4 \cdot \text{NOT-CLOSEST?}(c, t), \end{aligned} \tag{1}$$

time-based utility

$$\begin{aligned} u_c^{\text{time}}(t) = & \text{WAIT-TIME}(t) \\ & - p_1 \cdot \text{OTHER-CRANE?}(\text{PATH}(c, t)) \\ & - p_2 \cdot \text{HAS-TURN?}(\text{PATH}(c, t)) \\ & - p_3 \cdot \text{CHANGE-HEADING?}(\text{PATH}(c, t)) \\ & - p_4 \cdot \text{NOT-CLOSEST?}(c, t), \end{aligned} \tag{2}$$

time-and-distance based utility

$$u_c^{\text{time-distance}}(t) = -\text{DISTANCE}(\text{PATH}(c, t)) + u_c^{\text{time}}(t) \quad (3)$$



Distance-based

De-commitment Penalty	Average Wait Time (minutes)	Min of Max wait time (minutes)
0	14.37	41.30
100	15.42	37.93
10,000	15.04	45.65

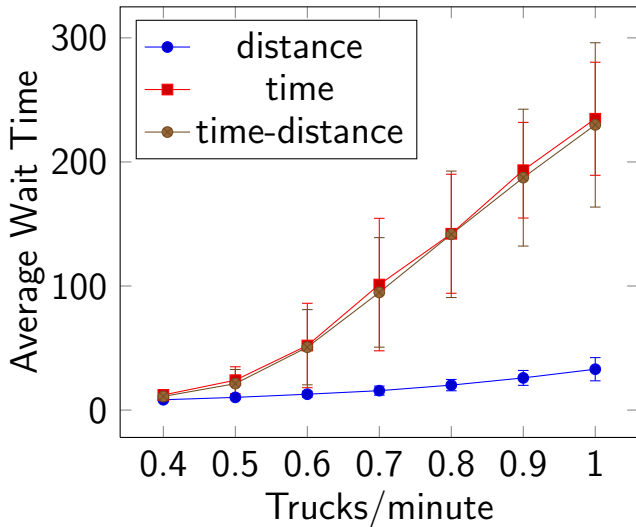
Time-based

De-commitment Penalty	Average Wait Time (minutes)	Min of Max wait time (minutes)
0	68.97	68.95
100	65.49	72.58
10,000	53.84	56.18

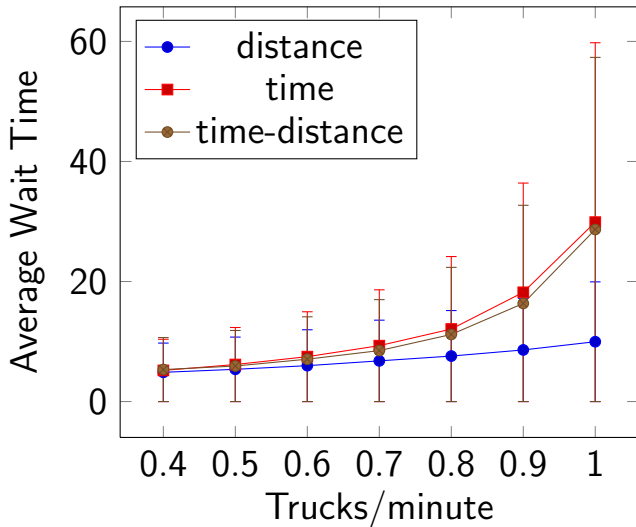
Time-and-distance-based

De-commitment Penalty	Average Wait Time (minutes)	Min of Max wait time (minutes)
0	68.04	86.38
100	65.42	67.97
10,000	52.24	56.77

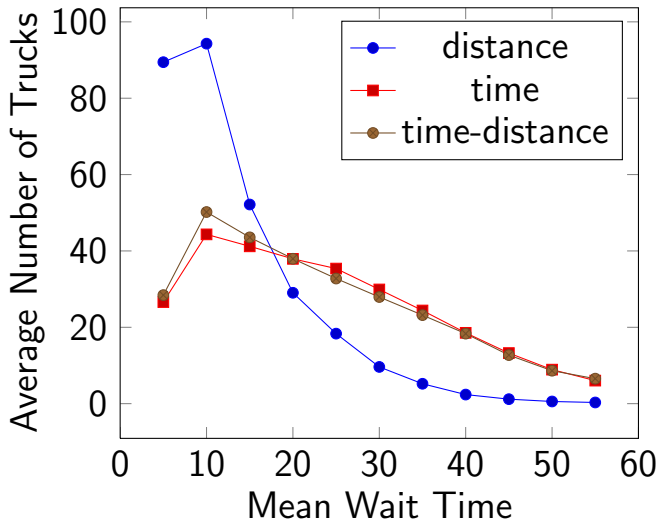
2 Cranes



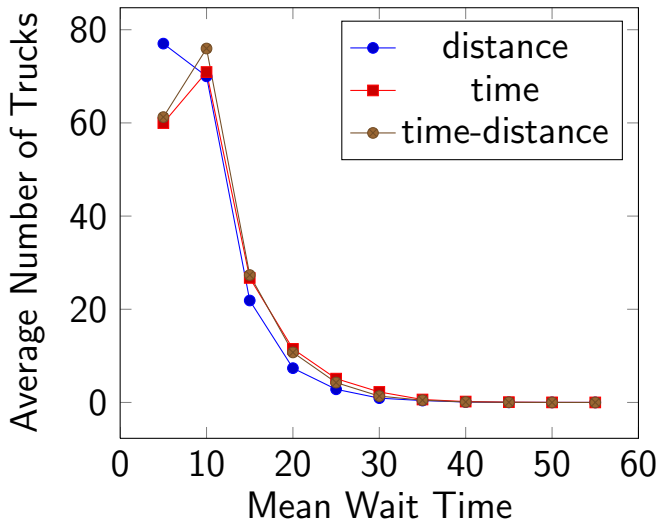
3 Cranes



Wait distribution. Truck arrival rate of .5



Wait distribution. Truck arrival rate of .3



Future Work

- ▶ We have crane operator logs. Dock model.
- ▶ Determine proper incentives.
- ▶ Full model: trucks, warehouses, container ports.