Building Agent-Based Models of Seaport Container Terminals

José M Vidal and Nathan Huynh

Department of Computer Science and Engineering
Department of Civil Engineering
University of South Carolina

11 May 2010
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 $g_c$

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

\[ u^\text{distance}_c(t) = -\text{DISTANCE}((\text{PATH}(c, t)) \]

\[ - p_1 \cdot \text{OTHER-CRANE}?(\text{PATH}(c, t)) \]

\[ - p_2 \cdot \text{HAS TURN}?(\text{PATH}(c, t)) \]

\[ - p_3 \cdot \text{CHANGE-HEADING}?(\text{PATH}(c, t)) \]

\[ - p_4 \cdot \text{NOT CLOSEST}?(c, t), \]

(1)
time-based utility

\[ u^\text{time}_c(t) = \text{WAIT\_TIME}(t) \]
\[ - p_1 \cdot \text{OTHER\_CRANE}?(\text{PATH}(c, t)) \]
\[ - p_2 \cdot \text{HAS\_TURN}?(\text{PATH}(c, t)) \]
\[ - p_3 \cdot \text{CHANGE\_HEADING}?(\text{PATH}(c, t)) \]
\[ - p_4 \cdot \text{NOT\_CLOSEST}?(c, t), \]

(2)
time-and-distance based utility

\[ u_{c}^{\text{time-distance}}(t) = -\text{DISTANCE}(\text{PATH}(c, t)) + u_{c}^{\text{time}}(t) \]
## Distance-based

<table>
<thead>
<tr>
<th>De-commitment Penalty</th>
<th>Average Wait Time (minutes)</th>
<th>Min of Max wait time (minutes)</th>
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</tbody>
</table>
2 Cranes

![Graph showing average wait time over trucks per minute with three lines representing distance, time, and time-distance.](image)

- **Distance** line
- **Time** line
- **Time-distance** line

The graph illustrates the relationship between trucks per minute and average wait time for different metrics.
3 Cranes

Average Wait Time

Trucks/minute

distance

time
time-distance
Wait distribution. Truck arrival rate of .5
Wait distribution. Truck arrival rate of .3

![Graph showing wait time distribution and average number of trucks]

- **distance**
- **time**
- **time-distance**

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Average Number of Trucks

Mean Wait Time

0 10 20 30 40 50 60

0 10 20 30 40 50 60
Future Work

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