Making Crosswalks Smarter: Using Sensors and Learning Algorithms to Safeguard Heterogenous Road Users

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Semi-Controlled Crosswalks

Ambiguity: “Yield to Pedestrian within crosswalks”.

Research Question: How do heterogeneous road users interpret the sign message?

Objective: Observe and analyze how people interpret the sign message.

Observing & Tracking

Big Idea: Analyzing how heterogeneous road users’ behavior requires “numbers”.

A Large Scale Spatial Temporal Trajectory Dataset

- Over 1 million instances are included.
- Records include more than 800 pedestrians/cyclists interacting with more than 500 motorists (heterogeneous road users).

Motion Predictions (ST-GCN-Seq2Seq)

Big Idea: Predict future trajectories of heterogeneous road users based on their observed trajectories and interactions.

Model Comparisons

<table>
<thead>
<tr>
<th>Evaluation Metric</th>
<th>Prediction Horizon (s)</th>
<th>Social Force</th>
<th>Seq2Seq</th>
<th>Social-LSTM</th>
<th>ConvSP-LSTM</th>
<th>ST-GCN-Seq2Seq</th>
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</thead>
<tbody>
<tr>
<td>RMSE (m)</td>
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</tr>
</tbody>
</table>

Conclusions

1. An open-sourced large-scale trajectory dataset.
2. Smart interaction at crosswalks:
   - Notify a subject road user of motion predictions of surrounding road users in real time.
3. Design of an intelligent tracking system at crosswalks:
   - The appropriate sensor (Miovision) can be deployed to capture the spatial-temporal positions of each road user.
   - Cellphone applications can be developed for tracking and motion predictions.