Week 4

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June 9, 2010
My Project

• Using the Intelligent Driver Model (by Dirk Helbing)

• Two Parts
  – Improve vehicle tracking using the IDM
  – Using tracking data, identify abnormal driving behavior
The IDM

• Developed by Sociologists
• Generally used to simulate traffic patterns.
• We would like to do the inverse and identify traffic behaviors by matching them to the model.
• Robust and accommodates both highway and city traffic patterns.
The IDM

\[
\dot{v}_\alpha = a^{(\alpha)} \left[ 1 - \left( \frac{v_\alpha}{v_0^{(\alpha)}} \right)^\delta - \left( \frac{s^*(v_\alpha, \Delta v_\alpha)}{s_\alpha} \right)^2 \right].
\]

\[
s^*(v, \Delta v) = s_0^{(\alpha)} + s_1^{(\alpha)} \sqrt{\frac{v}{v_0^{(\alpha)}}} + T^{\alpha} v + \frac{v \Delta v}{2 \sqrt{a^{(\alpha)} b^{(\alpha)}}}
\]

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Typical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desired velocity (v_0)</td>
<td>120 km/h</td>
</tr>
<tr>
<td>Safe time headway (T)</td>
<td>1.6 s</td>
</tr>
<tr>
<td>Maximum acceleration (a)</td>
<td>0.73 m/s²</td>
</tr>
<tr>
<td>Desired deceleration (b)</td>
<td>1.67 m/s²</td>
</tr>
<tr>
<td>Acceleration exponent (\delta)</td>
<td>4</td>
</tr>
<tr>
<td>Jam distance (s_0)</td>
<td>2 m</td>
</tr>
<tr>
<td>Jam distance (s_1)</td>
<td>0 m</td>
</tr>
<tr>
<td>Vehicle length (l = 1/\rho_{\text{max}})</td>
<td>5 m</td>
</tr>
</tbody>
</table>
Goals

• Using the IDM, identify drivers who exhibit “aggressive behavior”
  – Excessive accelerating or braking
  – Tailgating other drivers
  – Excessive or unsafe lane changes
  – Speeding

• Use the IDM to estimate vehicle position and track vehicles more accurately
Current Progress

• Using known vehicle data (position, acceleration, velocity, etc) the current model can identify vehicles with excessive acceleration/braking.

• The model is currently simplistic and too sensitive. Many more cars are recognized as “aggressive” than is reasonable.