A Modified Social Force Model (SFM) for Pedestrian Behavior in the Presence of Autonomous Vehicles (AVs)

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Are There Significant Behavioral Changes Of Pedestrians In The Way They Interact With Vehicles At A Crossing When A Portion Of The Vehicles Is Autonomous?

- How will pedestrians understand AV’s intention?
- How will pedestrians predict AV’s action?
- How will pedestrians interact with AV?
- How to decide to go or wait?

MODELING FRAMEWORK (Social Force Model)

\[ F_{av}^t = \text{All the personal desire related driving Force} \]
\[ + \text{all other pedestrian related repulsive Force} \]
\[ + \text{all other stationary object related repulsive Force} \]
\[ + \text{all the attraction related interaction force} \]

The force from the crosswalk boundary \( F_{x} \):
\[
\begin{align*}
F_{x} &= A_{x} \exp \left( -B_{x} \left| F_{x} - F_{x}^{a} \right| \right) \quad \text{if pedestrian inside the crosswalk} \\
F_{x} &= A_{x} \exp \left( -B_{x} \left| F_{x} - F_{x}^{a} \right| \right) \quad \text{otherwise}
\end{align*}
\]

DISCUSSION

Chaotic pedestrian movement indicates longer crossing times for pedestrians and causes longer crossing times. Longer pedestrian crossing times can impact traffic operations, cause further delays, and require adjustment in signal patterns at marked crosswalks and intersections.

The presence of AV on the road may not impact all the pedestrians at the crosswalk; however, one pedestrian’s chaotic crossing behavior will ultimately force the other pedestrian to be crossing the road chaotically.

The pedestrian inconvenience could lead to them choosing other modes of transportation, impacting overall transportation planning. This may require adjustments in traffic operations for mixed driving situations.

FUTURE WORK

- This model is intended to work for signalized crosswalks only, and new models or adjustments are needed to model an unmarked crosswalk.
- Various assumptions were made for the simulation, such as no right or left-turning vehicle in that intersection.