Instrumented Vehicle Study and Microsimulation Models of Pedestrian-Vehicle Interaction at Midblock Crosswalks

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Motivation

In commercial microsimulators today, vehicle–pedestrian interaction is modeled on a macroscopic scale rather than as individual interactions:

- All Vehicles yield to Pedestrians
- All Pedestrians yield to Vehicles
- Global or site–specific yield rate
Data Collection Efforts

- Driver Yielding Study – Presented yesterday
- Pedestrian Survey – Poster
- Instrumented Vehicle Study
Instrumented Vehicle Study

- Data collected in order to recreate vehicle movement during yielding events
  - Distance from crosswalk that deceleration begins
  - Magnitude of deceleration
  - Yielding position (hard yield)
  - Deceleration profiles (soft yield)
Methodology

- Drivers will be “blind” participants
- Drivers will drive for approx. one hour on the UF campus—multiple routes totaling 53 crosswalks
- Driver characteristics (age, experience, gender, familiarity with campus) will be recorded
- Surveys will be filled out before, between routes, and after study completion
- GPS and integrated video will be used for data collection
Pilot Results

Yield Distance

Speed Profile - Pilot

Speed vs. Time - Pilot

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Pedestrian-Vehicle Interaction Framework

CORSIM

Vehicle Model

Pedestrian Model

Car Following

Safety Decisions

Yield Model

Vehicle Interaction

Social Forces
Pedestrian Simulator

- In the current version of CORSIM, pedestrians are not modeled microscopically.

- When pedestrians and vehicles interact, the current version of CORSIM applies a delay to vehicles based on the pedestrian flow rate.

- This methodology, along with the limitation of a 1 second simulation time step, does not allow for analysis of pedestrian operation.
Pedestrian Simulator (cont.)

- Social Forces Model implemented in C#
  - Pedestrians move according to attraction to their destination and repulsion from other pedestrians and obstacles
  - Phenomenological– queuing and channelizing emerge naturally rather than by definition
  - Significant work has been done for calibration and validation
  - Elliptical specification of interactions is utilized

- Integrated with CORSIM (in development)
Pedestrian Simulator

Video Example
Pedestrian-Vehicle Interaction Framework

CORSIM

Vehicle Model

Pedestrian Model

Vehicle Following
Safety Decisions
Yield Model
Vehicle Interaction
Social Forces
Pedestrian Interactions with Vehicles

- Pedestrians wait at the edge of the crosswalk for gaps/lags or yields.

- Gap acceptance models are utilized, and an acceptable gap must be identified in each of the lanes until a refuge to the other side.

- Yielding may trigger the gap acceptance model or is recognized by pedestrian.
Pedestrian-Vehicle Interaction Framework

CORSIM

Vehicle Model
- Car Following
- Safety Decisions
- Yield Model

Pedestrian Model
- Vehicle Interaction
- Social Forces
Vehicle Interactions with Pedestrians - Yielding

- Vehicles utilize a discrete choice model at a decision point upstream of the intersection when a pedestrian is waiting.

- Vehicles can either:
  - Hard Yield (come to a complete stop) or
  - Soft Yield (deceleration < full stop deceleration)

- This model is re-run if the vehicle is stopped and another pedestrian has arrived.
Pedestrian-Vehicle Interaction Framework

CORSIM

Vehicle Model

Pedestrian Model

- Car Following
- Safety Decisions
- Yield Model
- Vehicle Interaction
- Social Forces
Vehicle Interactions with Pedestrians - Safety

- Pedestrians are given the right of way in all conflicts—even if vehicle had decided not to yield.

- Vehicles can observe and predict pedestrian movement in order to decelerate for emergency braking.

- Vehicles who have yielded for a pedestrian will also give way to following pedestrians with potential conflicts.
Conclusions

- The instrumented vehicle study will provide data for deceleration profiles and decision points used in the simulator.

- The integration of microscopic pedestrian simulation in CORSIM provides benefits in modeling multi-modal facilities.

- The proposed vehicle-interaction framework allows for true microscopic modeling of pedestrian-vehicle interaction.
Thank You

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