BILAT USA 4.0

THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

Smart Cities: Providing Mobility to All

A vehicle-pedestrian interaction environmeny

CITR | Control and Intelligent Transportation Research Lab

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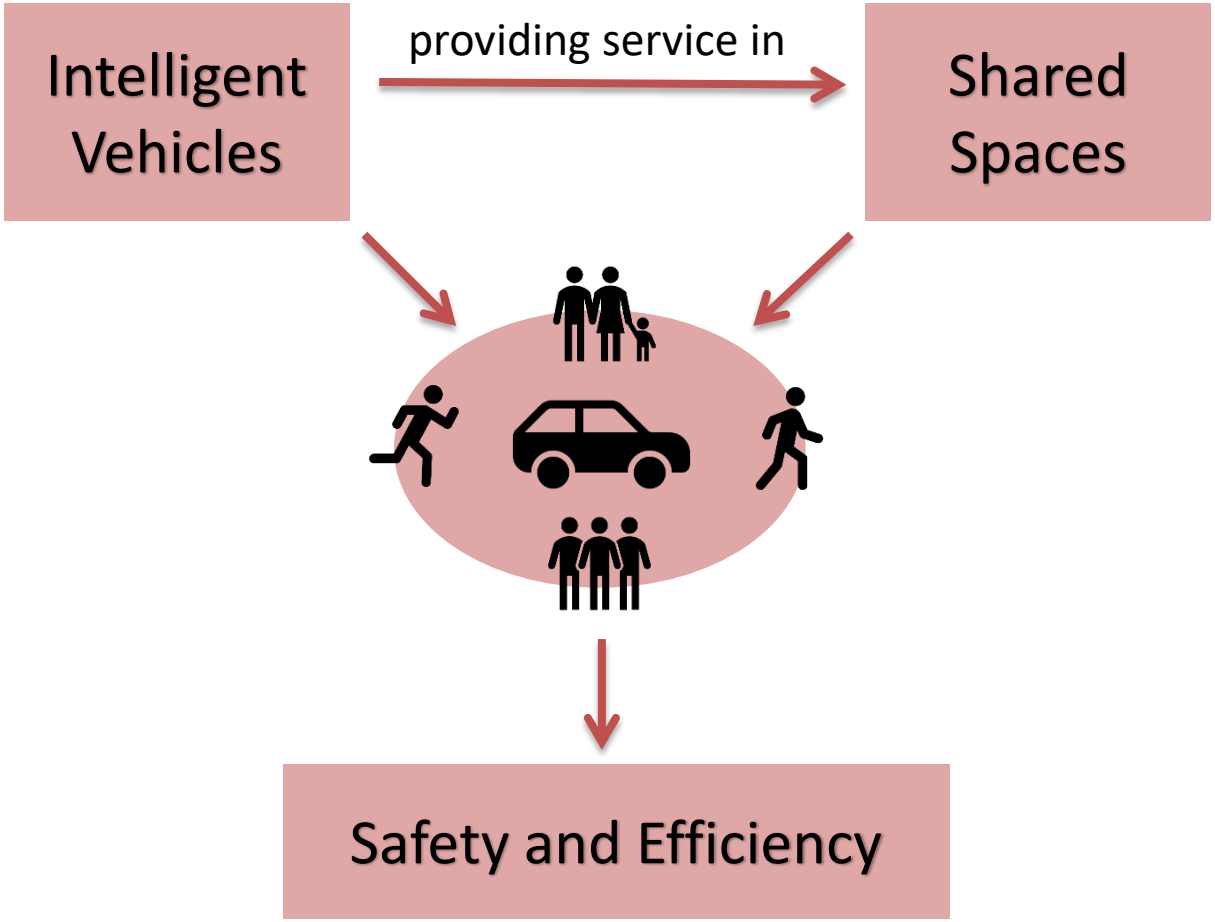
What we can consider providing…

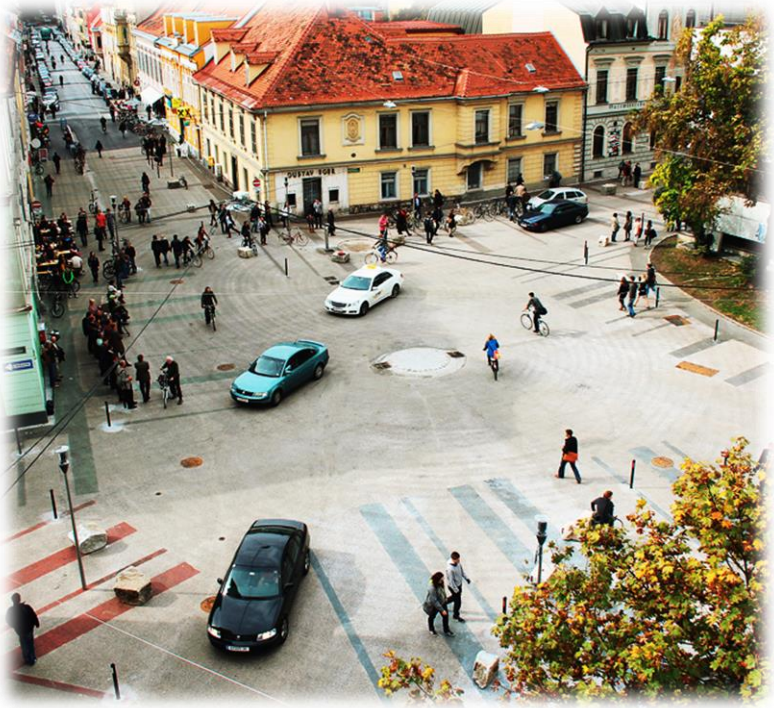
- **Need 1:**
  - Scheduled or on-demand access to mobility for the mobility impaired
- **Need 2:**
  - Safe, reliable transport of individuals in dense pedestrian areas

Background - Motivation



Background - Motivation

Vehicles in shared space



Normal size passenger car

Mobility Scooter

Golf cart

Background - Related Projects

Projects exploring intelligent vehicles in shared space

Auro: self-driving electric golf carts ferrying students on university campuses

CityMobil2: a pilot platform for automated road transportation systems

LUTZ Pathfinder: driverless pods providing service on public streets

Background - Related Projects

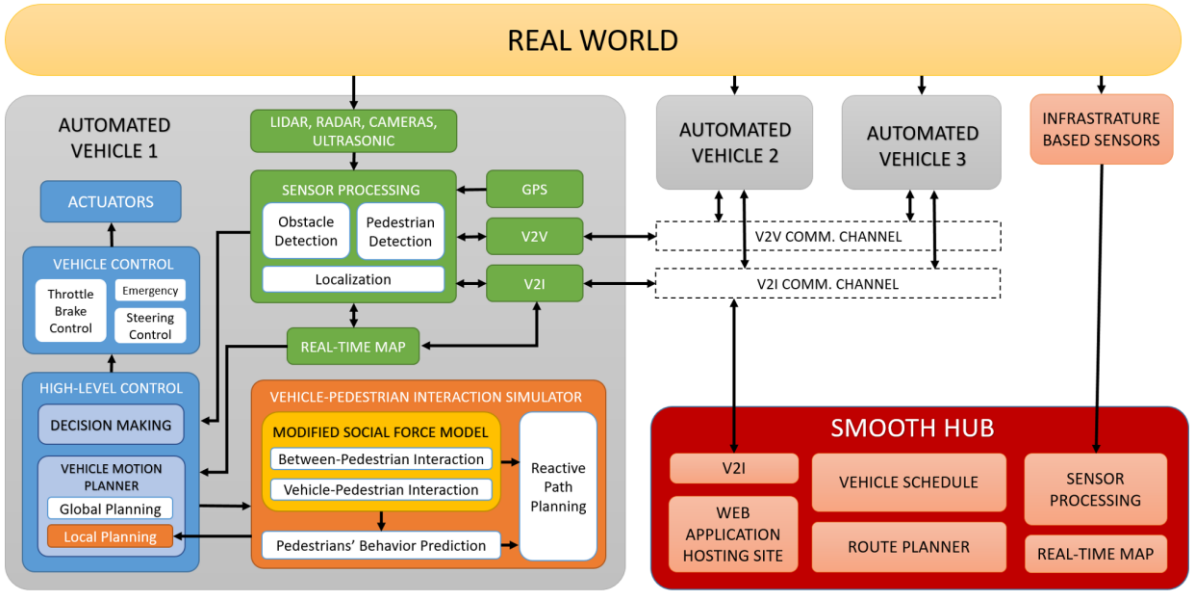
The Smart Mobile Operation: OSU Transportation Hub (SMOOTH)

- Providing first-mile/last-mile transportation.
- Servicing primarily on campuses.
- Scheduling via multi-platform web-based applications.

Electric wheelchair

Mobility scooter

Four-passenger golf cart



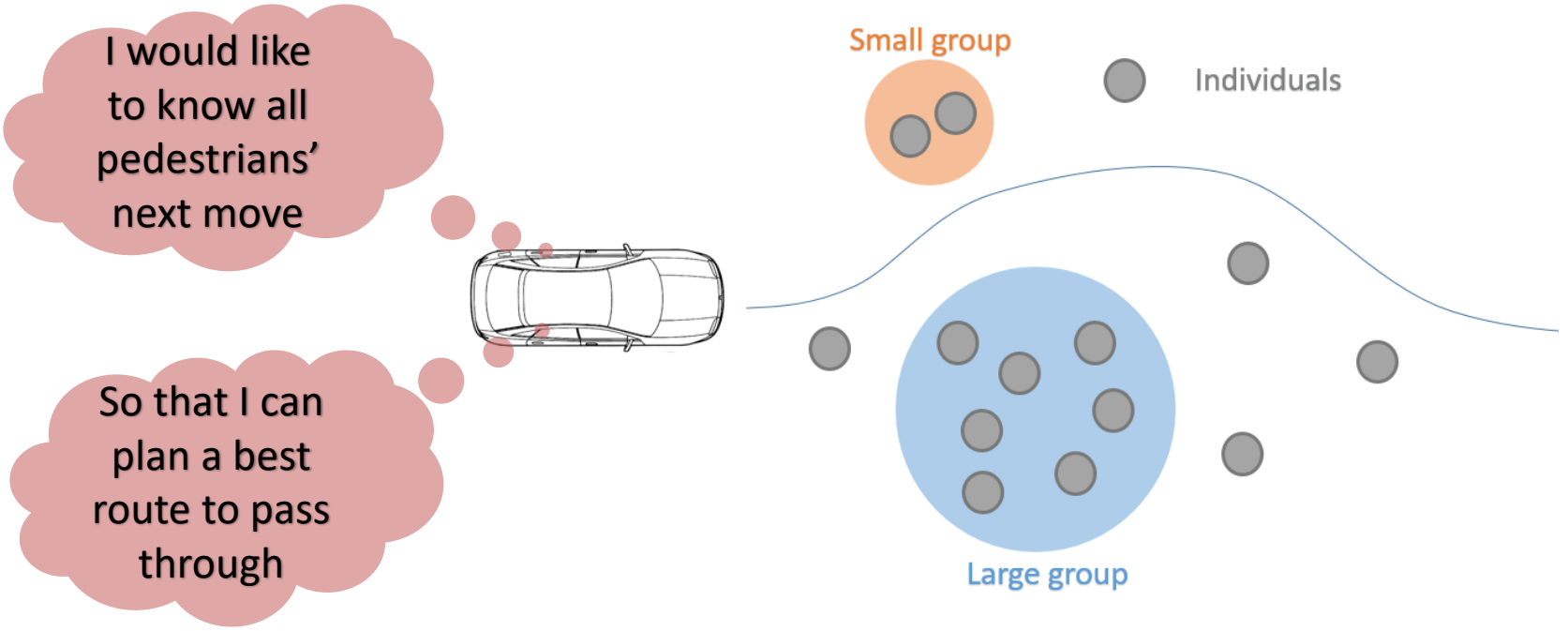
SMOOTH architecture

Background - Problem Statement

Question: Can we find a method to improve the safety and efficiency of intelligent vehicles surrounded by pedestrians in shared space?

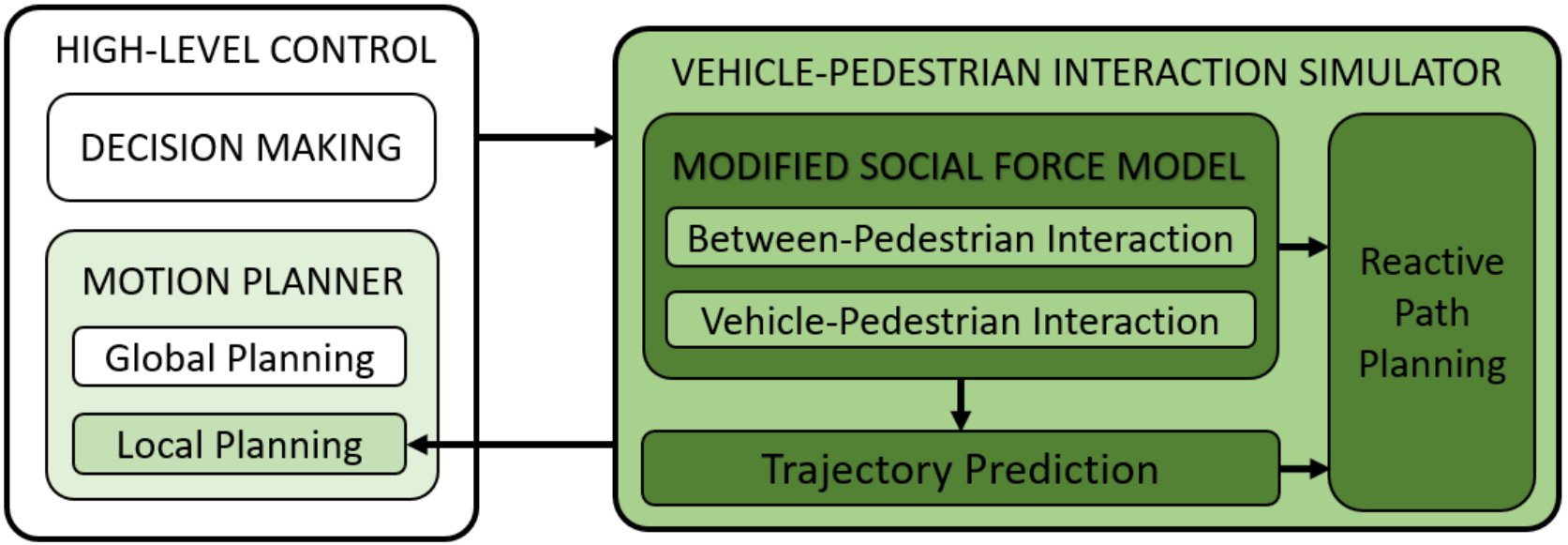
Answer: Yes! By viewing pedestrians in a higher viewpoint.

By predicting pedestrians' group behavior



Modeling - Model in SMOOTH

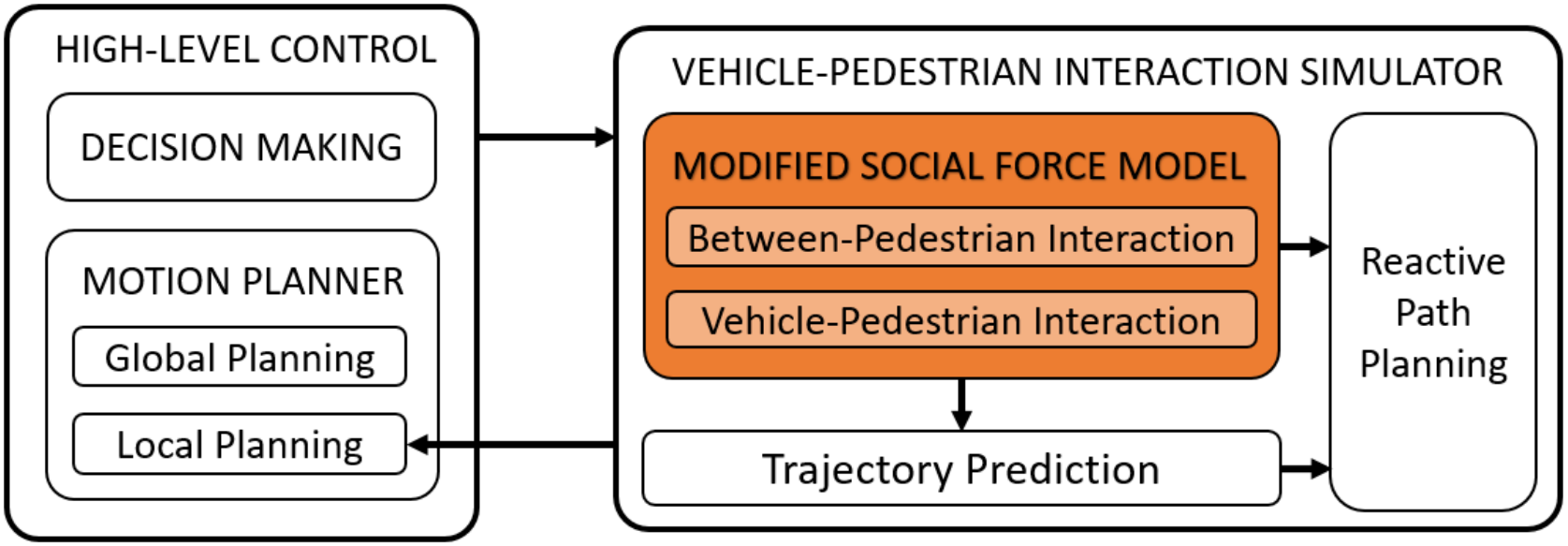
How does it work in automated vehicles?



- **Get information** of pedestrians and environment.
  Information can be obtained from sensors, other vehicles, and infrastructure via communications
- **Simulate** and predict the pedestrian behavior**.**
  Different vehicle configurations can have different simulation results
- **Send** simulated information to **local motion planning**.
  Additional information can improve motion planning performance.

Modeling – Modified Social Force Model

Fundamental Interaction Mechanism:



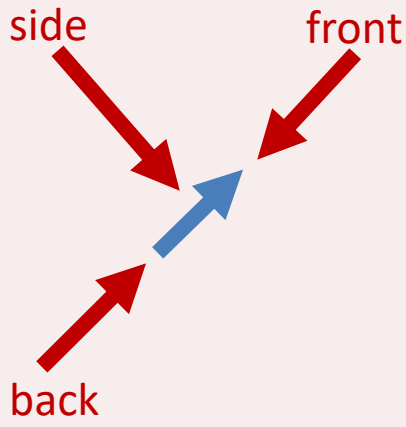
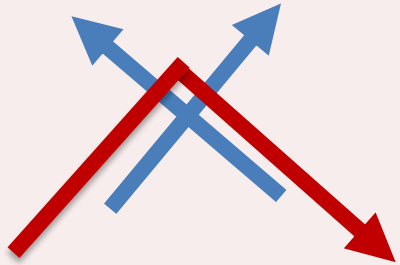
Modified Social Force Model

- **Social Force Model**: first introduced in 1995 by D. Helbing and P. Molnar.
  - Wide application in pedestrian behavior analysis of building design

Reference: D. Helbing and P. Molnar. 1995. Social force model for pedestrian dynamics. *Physical Review E* 51 (May 1995), 4282.

Simulation – Scenario Construction

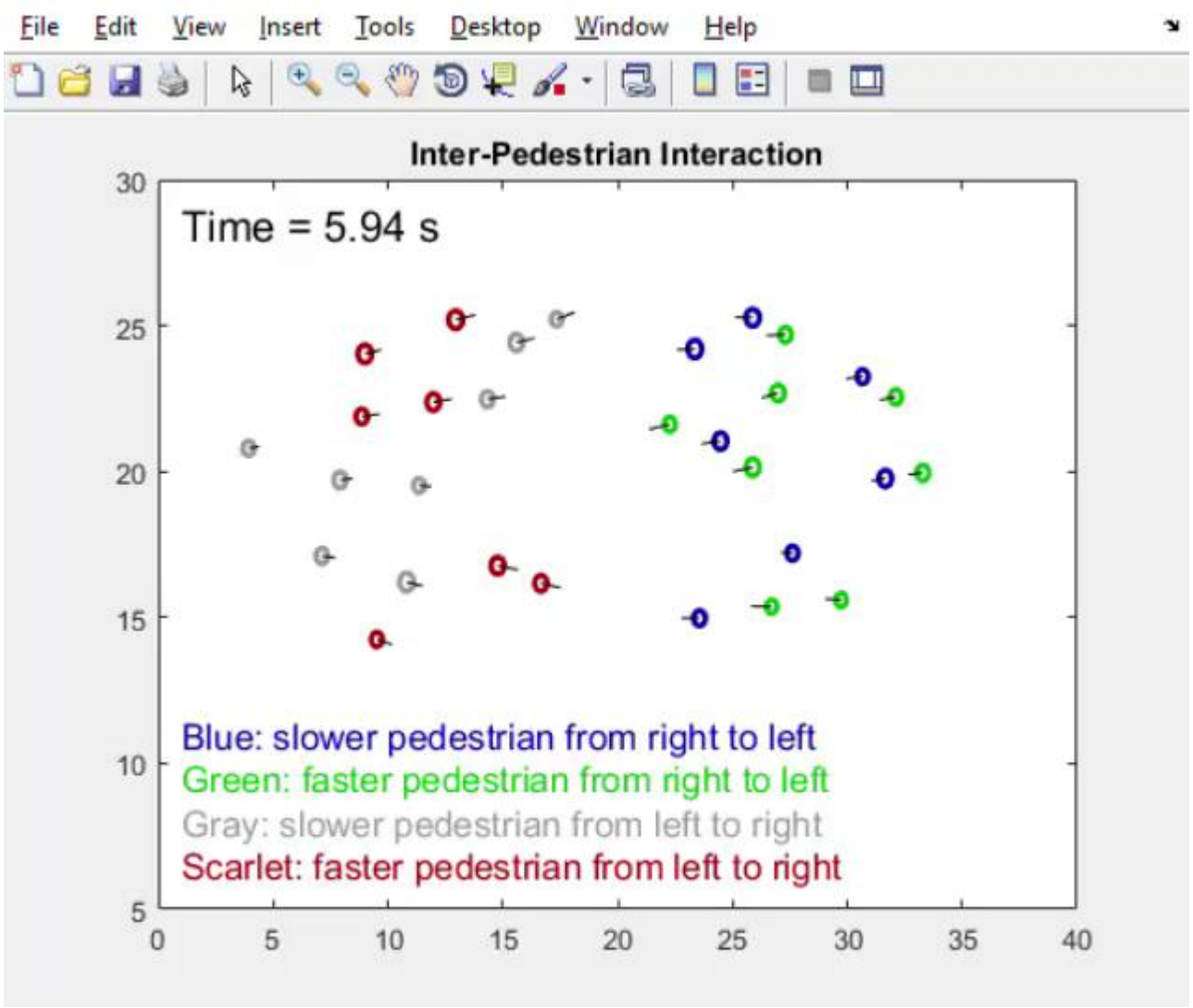
Three Scenarios to evaluate this model

Inter-Pedestrian Interaction	Basic Vehicle-Pedestrian Interaction	Advanced Vehicle-Pedestrian Interaction
		

 Motion of pedestrians

 Motion of vehicle

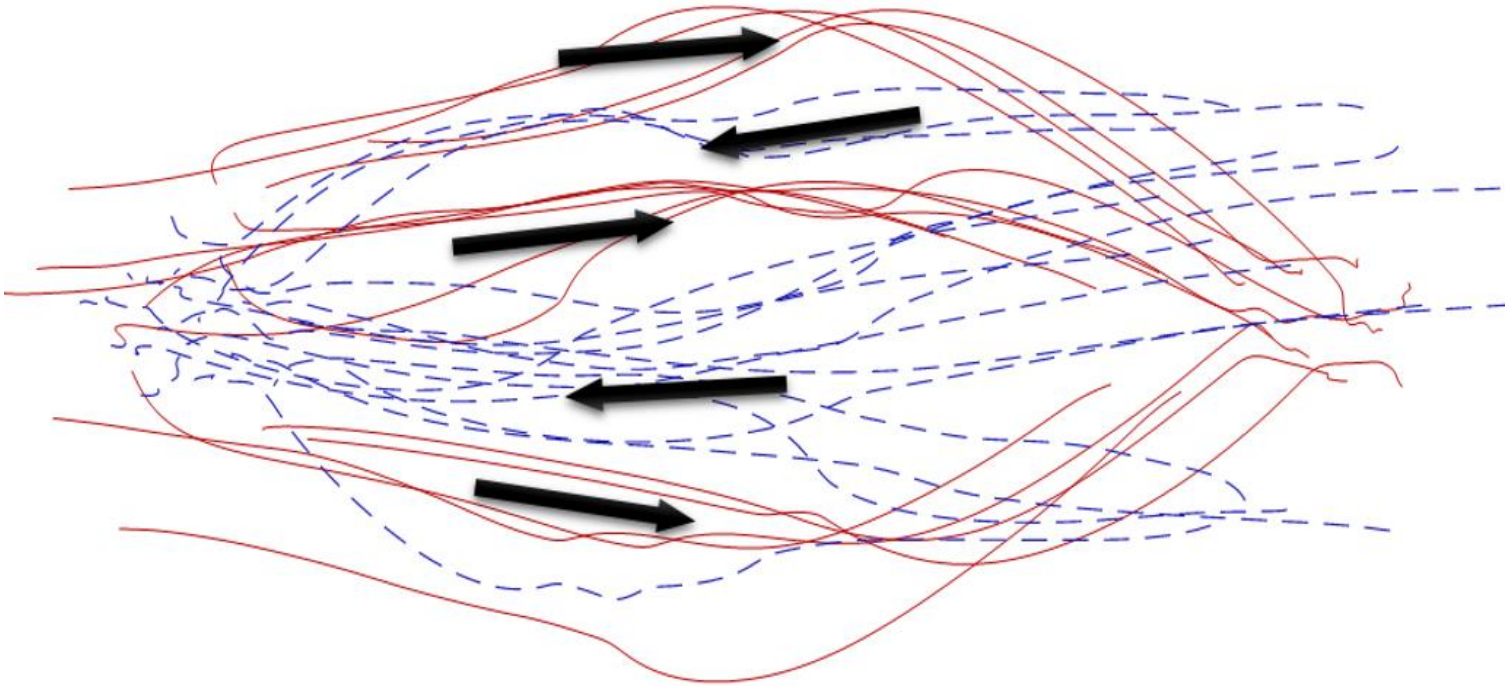
Simulation – Inter-Pedestrian Interaction



Download: https://drive.google.com/open?id=0B0L-zPpY7vhkc0pFbW5SSkJ5S0E

Simulation – Inter-Pedestrian Interaction

Recorded trajectories show lane formation



Summary

- The proposed simulation model can properly simulate vehicle-pedestrian interaction.
- Scenarios can be easily constructed and simulated.
- Various vehicle control and path planning algorithms can be tested.
- If necessary, characteristics of individual pedestrian can also be specified.

- Most importantly, this model has the potential of improving vehicle local motion planning algorithm in shared space, by providing societal pedestrian group behavior prediction.

Summary

Thank You! Questions are welcome!