Multi-agent Simulation about Mixed Traffic of Cars and Pedestrians

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1. Objective

In a society excessively depending on car traffic, a person who cannot drive a car cannot enjoy his/her comfortable life. Traffic accidents caused by elderly people have become a big social issue in Japan, one of rapidly progressing aging societies. One of possible solutions to such issues is to suppress the dependency to car traffic of the society, to create human-centered road space, and to construct new traffic systems that consider the mobility-impaired people.

The pedestrian's existence becomes more important in such a new traffic system. However, there are few examples of mixed traffic simulation of pedestrians and cars in which the subjectivity of pedestrians is treated in the same way as cars. In this research, we construct a simulation method where coexistence of pedestrians and cars can be expressed.

2. Methodology

We newly develop a multi-agent-based traffic simulator, where pedestrians and cars are modeled as intelligent agents. Each car agent decides its acceleration according to the generalized force model (Helbing, 98). On the other hand, the acceleration of each pedestrian agent is calculated by the social force model (Helbing, 95). A car agent moves on a one-

dimensional lane, and a pedestrian agent moves on two-dimensional walkway.

In order to express the effect of grouped pedestrians and car-pedestrian interactions, we introduced a new model named "multilevel pedestrian model". Pedestrian convoy agents and pedestrian swarm agents are added in the model. The pedestrian convoy agents are virtual agents to control interactions among pedestrian groups. The pedestrian swarm agents are virtual agents to control car-pedestrian interactions. Acceleration vector of a pedestrian is calculated from virtual external force in the social force model. The multilevel pedestrian model follows this concept; the effects of virtual agents are conveyed as external force. Figure 1 shows the overview of the multilevel pedestrian model.
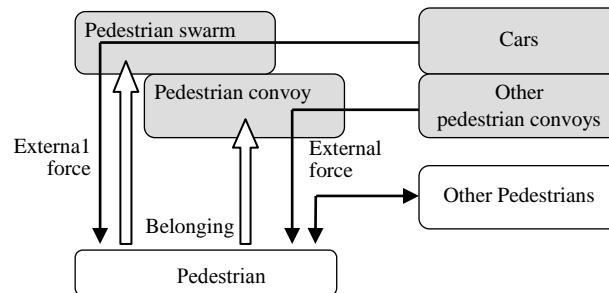

Figure 1: The concept image of the multilevel pedestrian model

3. Results / Findings

We simulated car-pedestrian interaction at a signalized simple crossroad with zebras in order to verify the new model. The number of car agent was set to 500, 1000, 2000, 3000 units/hour, and one-third of generated cars tried to turn left at the crossroad while avoiding contacts with pedestrians. The traffic volume of pedestrians affects the number of cars that finished turning left. The number of turning-left cars and pedestrians are shown in Figure 2. It agrees well with theoretical values (JSTE, 1984).
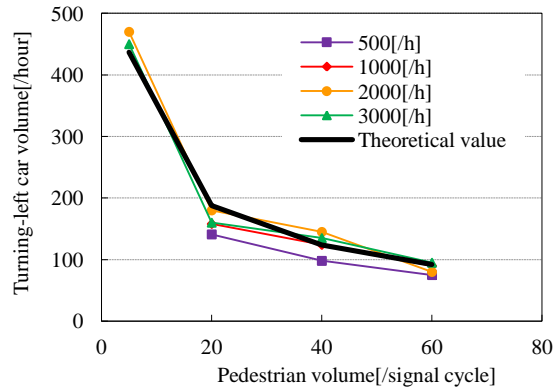
Figure 2: Effect of pedestrian on the number of turning-left car

We simulated mixed traffic at the scramble crossing in front of Shibuya station (Tokyo) for confirmation of microscopic interaction among agents as well. Figure 3 shows an example of visualization. Red and blue squares indicate cars and green dots are pedestrians. Light-green lines between pedestrians indicate the existence of pedestrian convoy agents.
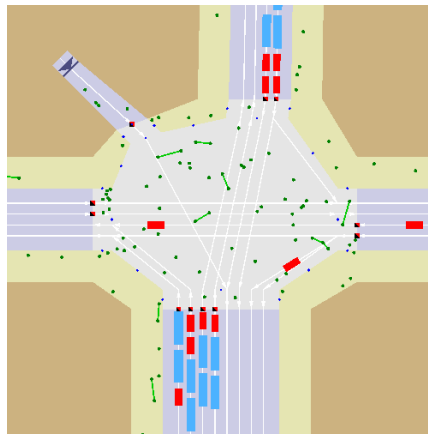

Figure 3: Visualization image of mixed traffic simulation

4. Implications for research

In this research we developed a new simulator for mixed traffic by combining the multilevel pedestrian model with a conventional car traffic simulator. Even though we still need to improve reproductivity and versa-

tility of the model, it will be able to support decision making about redevelopment of the area around a shopping mall or a sightseeing facility that places great importance on pedestrians.

References

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