Within-Day Replanning of Exceptional Events (12-1586)

After events like the disruptive terrorist that cost several regions around the Indian Ocean in December 2004, or the devastating earthquake and subsequent tsunami in Japan in March 2011, the management of exceptional events has become an important topic. Agent-based micro-simulations are suited for the simulation of complex situations where unforeseeable exceptional events occur. This requirement conflicts with traditional simulation approaches that optimize traffic demand considering an upper bound of the feasible travel time. Therefore, the decision-making process of an agent becomes an important topic. In an iterative approach, each agent recalculates its plans before the start of the next simulation. As a result, a simulation will not converge to a user equilibrium. Decisions made during the simulation are time-consuming, and the assumption of unrealistic information may lead to a behavior in the future reporting the demands of a trip with an event.

A within-day replanning approach uses a significantly different strategy from that of an iterative approach. Instead of planning on the basis of an initial plan, a decision is made to adapt the current plan of action. The decision involves the selection of a plan that represents the future state of the system and can be adapted during the simulation. This approach allows the system to react to changing events and conditions in real-time, which is critical for systems with real-time constraints.

Behavioural Models

In the BDI approach, the level of an agent’s information is represented by its beliefs, e.g. about traffic flows in a certain region. The belief model allows agents to reason about the current state of the world and to plan actions accordingly. The decision-making process of an agent becomes an important topic. In an iterative approach, each agent recalculates its plans before the start of the next simulation. As a result, a simulation will not converge to a user equilibrium. Decisions made during the simulation are time-consuming, and the assumption of unrealistic information may lead to a behavior in the future reporting the demands of a trip with an event.

Conclusion and Outlook

Future steps will include a behavioral model based on the full integration of the BDI approach into the framework. The behavioral model will allow agents to reason about the current state of the world and to plan actions accordingly. This will enable the system to react to changing events and conditions in real-time, which is critical for systems with real-time constraints.

Application

We explain why traditional simulation approaches fail in scenarios with unexpected exceptional events, while with replanning, the more affected agents use replanning to adapt the initial plan. The results show that the higher the replanning buffer, the lower the mean travel times can increase again, if too many agents use within-day replanning. Moreover, those agents will only adapt their plans if they are within a certain distance of the affected links. Additionally, the behavior model can be adapted to a different level of replanning buffer, and the results show that the higher the replanning buffer, the lower the mean travel times can increase again, if too many agents use within-day replanning. Moreover, those agents will only adapt their plans if they are within a certain distance of the affected links.

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