Adding Public Transport to MATSim
Motivation

• Current agent-based simulation usually only looks at private car traffic

• Current traffic measures target time-dependent and mode-share effects
  ◦ e.g. time-dependent tolls

• Different modes of transportation may influence each other
  ◦ cars, buses, streetcars, pedestrians all share the same infrastructure
Goals

• Agent-based simulation of private car and public transit traffic

• Schedule-based simulation of transit traffic
  ◦ but include effects of transit congestion

• Interaction between transit vehicles and private cars
  ◦ cars may have to stop behind a bus at a stop

• Mode choice in simulation influenced by interaction
  ◦ if cars are slowed down because of transit, agents may change from car to transit; if transit is too crowded, agents may decide to use car
Implemented Public Transit Simulation

• Use transit schedule as simulation input
  ◦ contains information about stop locations, transit lines, their routes, departure times

• Routes of transit lines must be described in a network
  ◦ network can be multimodal
  ◦ network can be shared with other modes, e.g. car

• If transit network is missing, a network can be generated from schedule information
  ◦ no interaction between other modes of transportation possible in this case
Additional Features Implemented

• Waiting time of vehicles at stop locations depending on number of passengers entering and leaving the vehicle

• Transit vehicles can block other cars at stops
  ◦ e.g. when bus bays are missing

• Calculating routes using transit schedule for agents in simulation
  ◦ currently simple earliest-arrival approach

• Agents use walk mode with estimated walk time to travel between activity locations and stop locations
Demo

- Bus bunching
- Different stop locations
- Passengers switching lines
Large-Scale Application: Zurich

• Area of Zurich, Switzerland

• 1.8 million agents
  ◦ everybody living in Switzerland who has at least one activity in the area of Zurich

• Road network with over 60k links and 24k nodes
  ◦ Swiss regional planning network

• Generated transit network with 6533 links and 3245 nodes
  ◦ Includes all trains departing/arriving in Zurich as well as regional transit offerings in area of Zurich
Large-Scale Application: Zurich: Road Network
Large-Scale Application: Zurich: Transit Network
Large-Scale Application: Zurich: Combined Network
Simulation Outcome

- Car users
- Transit users
- Train stops
- Other transit stops
Simulation Outcome: Train Lines Highlighted

- car users
- transit users
- train stops
- other transit stops
Simulation Outcome

High share of transit users
High share of car users

- car users
- transit users
- train stops
- other transit stops

Multi-Agent Transport Simulation (MATSim)
• Zurich has a good rapid-transit railways system

• Remove one line ("S7") from the model

• Calculate share of transit users for each municipality

• Compare to share of transit users in model with S7 included
Sensitivity Study: Transit Lines

Source: www.zvv.ch
Sensitivity Study: Transit Lines

- S7 is the only transit line here
- S7 does not stop here
- S7 is the only transit line here

Source: www.zvv.ch
Sensitivity Study: Outcome

Absolute change in share of transit users per municipality in %
Sensitivity Study: Outcome

Absolute change in share of transit users per municipality in %
Outlook

- The transit simulation is also used for Berlin scenario
- Transit Router is quite simple (and slow) at the moment, needs more work for future usage
- More transit-specific analyses
- Improved visualization of transit vehicles and passengers
Outlook: Example

Number of passengers entering

Number of passengers leaving

Number of passengers in vehicle
Conclusions

• Detailed, large-scale, agent-based simulation of public transit is feasible

• Agent-based transit simulation is able to capture small differences in transit accessibility
  ◦ more details than simulation models using zones, as also intra-zonal aspects are considered

• Agents can improve the mode choice during the simulation compared to pre-calculated mode choice
  ◦ aggregated, averaged values in pre-calculation; simulation can split up averages into single decisions again