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Performance Improvements for Large Scale Traffic Simulation in MATSim

Rashid Waraich

IVT
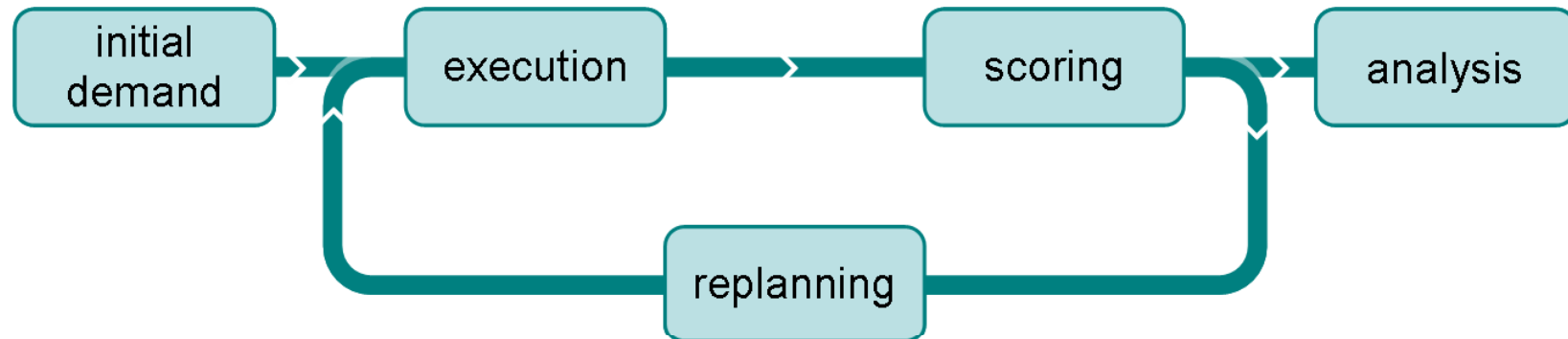ETH
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Motivation

Co-evolutionary simulation process of MATSim*:

*Multi-Agent Transport Simulation Toolkit

Motivation (cont.)

MATSim simulation time depends on...

- Micro simulation: Number of simulated trips
    - Number agents
    - Network resolution (60K -> 1M links)
        - Intelligent Transportation Systems (ITS)
        - GPS surveys
        - Commerical applications

- Processing simulation output
    - E.g. Scoring, CO2 emissions, etc.
- Replanning modules

# Options for Micro Simulation Performance Improvement

- Possible simulation approaches
  - Fixed time steps
  - Simulate only relevant events (faster)
- Using multiple processors for the computation
  - C++ (Message Passing Interface - MPI)
    - Integration overhead with Java
  - Graphics Processing Unit (GPU)
    - Integration overhead with Java
    - Limited memory (1GB vs. 10 – 100 GB)
  - Java
    - No integration overhead, as programmed MATSim in Java
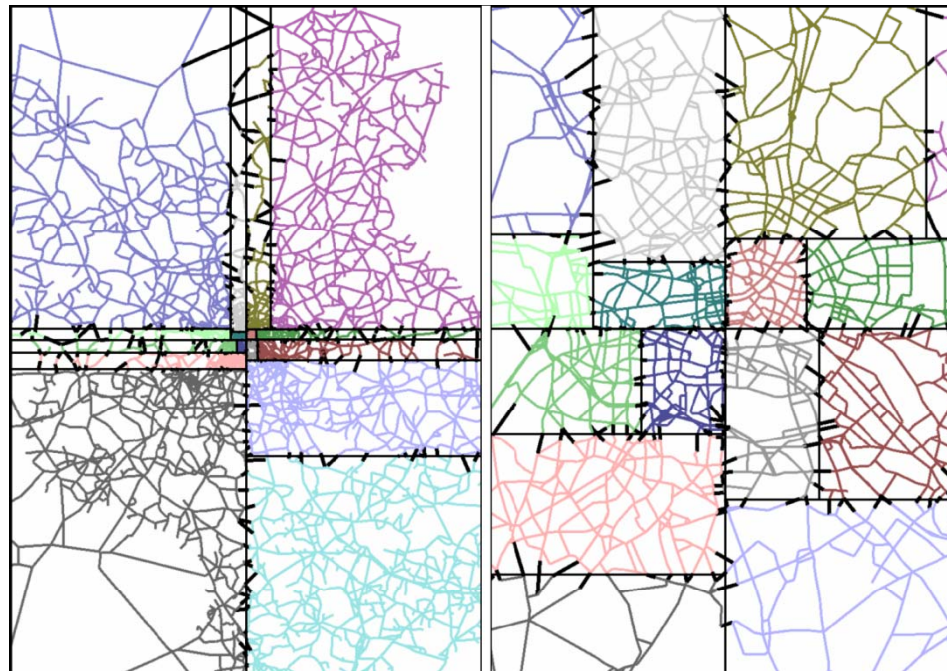   - Some challenges...

Amdahl's Law
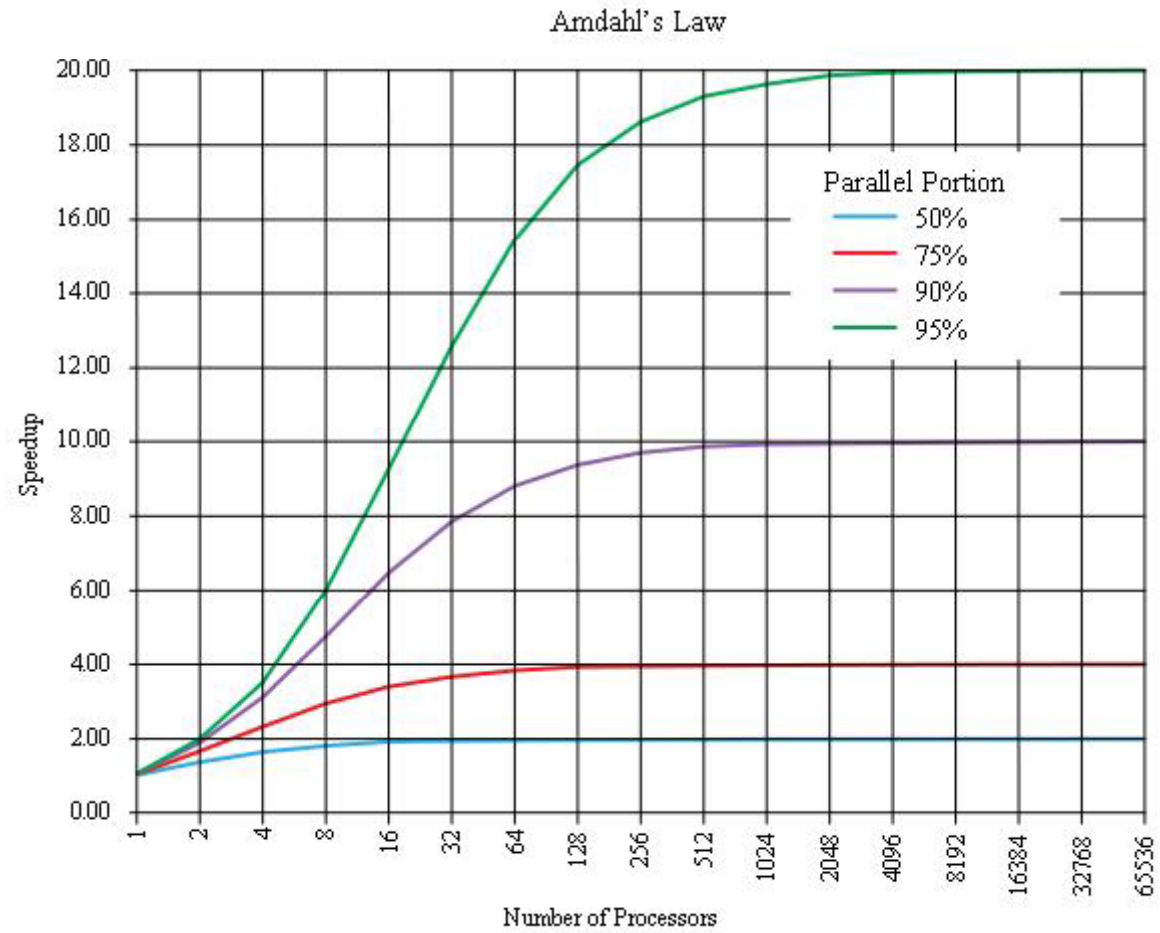
[wikipedia.org]

Performance Experiment (614K agents, 882K links)
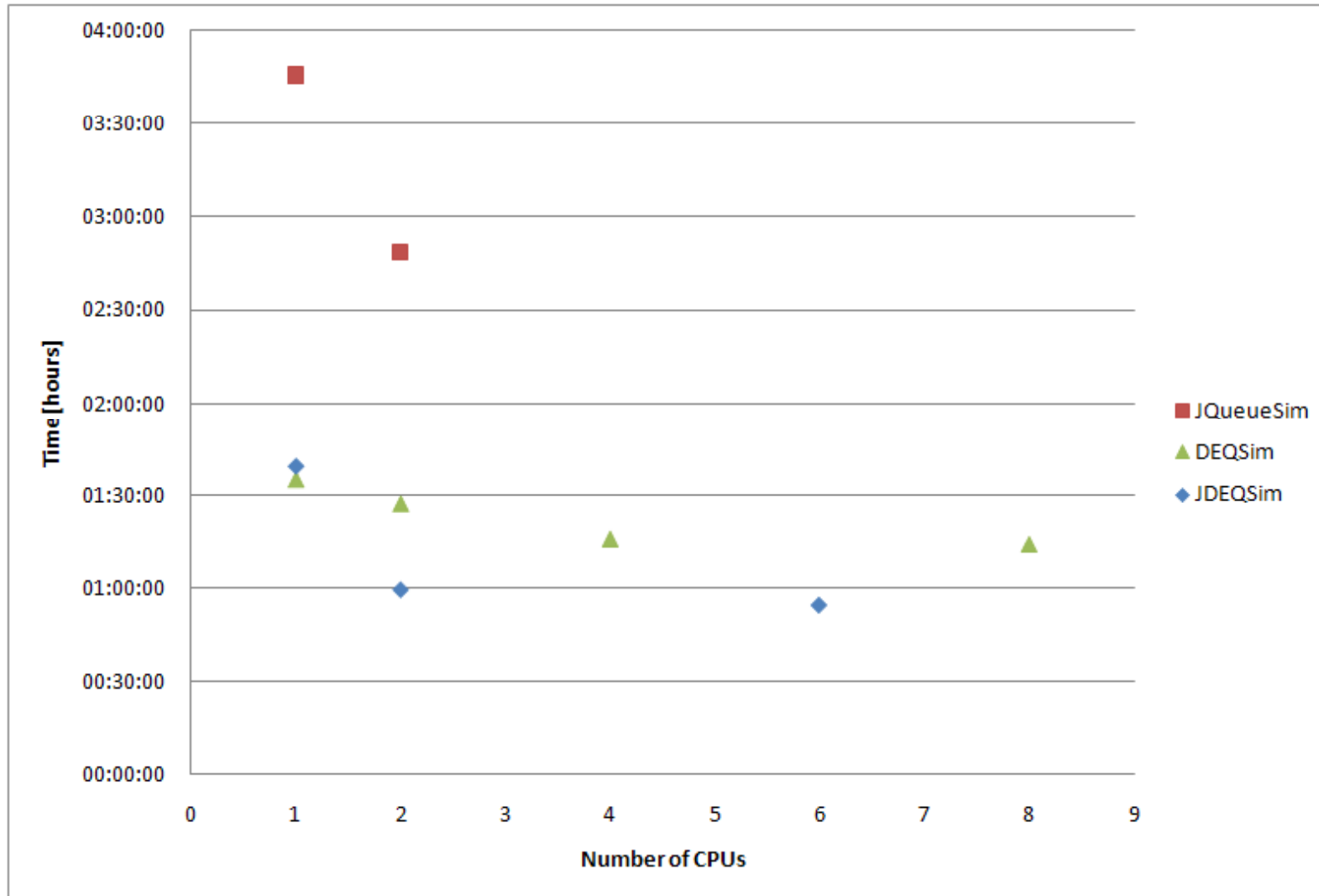
Domain Decomposition

Charypar, D., K. W. Axhausen, and K. Nagel (2007) An Event-Driven Parallel Queue-Based Microsimulation for Large Scale Traffic Scenarios, paper presented at the *11th World Conference of Transport Research*, Berkeley, June 2007.

Parallel Micro Simulation in Java

- Speed up of around 1.6 achieved with 2 CPUs.

- Correctness of method not proven yet

- The method works as follows:

  - We loosen the coupling between the CPUs. This might produce minor differences, but these are in the order of seconds

  - Small difference in simulation time between the CPUs is acceptable.

Conclusions

- MATSim is well known for large scale high performance traffic simulation. And now even higher resolution scenarios can be simulated in MATSim in less time. And hope, that this will get even faster in future.

Questions?