Agent Based Micro-Simulation of PHEVs

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March 2011
Two part of Presentation

• Overview of MATSim
• Current work: A framework to investigate PHEVs (based on MATSim).
Some requirements of PHEV research community

• **Electricity demand** changing in terms of location and time of day
  • charging power/speed can vary between locations
  • Influence/bottlenecks in lower voltage grid?
• Need to distinguish electric vehicles and PHEV
  • PHEVs more flexible due to gasoline tank
• Vehicles with batteries could potentially supply the grid (V2G, V2H)
  • What is the role of battery size in terms of V2G and emissions
• Ability to incorporate individual agent’s preferences
  • E.g. parking price, distance, income, location
• Government policy (e.g. Parking advantage for electric vehicles, street tolls)
• Fleet modelling: Emissions analysis (e.g. green house gas emissions after change of a policy)
Some requirements of PHEV research community

- **Charging Schemes**
  - Decision by agents (manually)
  - Decisions by electric grid (e.g. smart grid)
  - Decisions by on board computer of cars (automatically)
    - E.g. based on current state of charge, distance to next destination(s), charging price (changing over the day), parking duration, max unchargable state
- Energy Exchange (buying and selling electricity)
- Analyzing black outs (focusing on detailed analysis instead of on rough numbers)
- ...

=> **The proposed PHEV framework helps answering such questions.** Many of these features have already been implemented.
PHEV Framework Overview (Core Modules)

Vehicle energy consumption regression model (LAV)

Vehicle (e.g. conventional vehicles, EV, PHEVs) (includes vehicle charging policy)

Decentralized smart charging

Energy management module
(incl. charging strategy)

Immediatly start charging

Dual tariff charging

Centralized smart charging

Infrastructure information/boundary conditions: Electric plug power, electricity price, parking type, etc.

Swapping stations

Energy exchange

Vehicle fleet composition

Energy output module

General feedback module (e.g. price signal feedback from PSL)

Energy price scoring module
Plugging-in Feedback Module into PHEV Framework

PHEV Framework

- initial demand
- simulation
- charging module
- scoring
- relaxed demand
- replanning
- PMPSS

grid constraint violations? charging demand information
Joint Experiments

- Test experiments conducted in October 2009
  - Matthias Galus will present later
- At the moment we are working on setting up a scenario for the city of Zürich
Work in Progress and Future Work

- Decentralized smart charging
- V2G
- Integration of general energy source/storage concept (e.g. solar panels)
- Energy exchange
- Swapping stations
Questions?