Agent based modeling and simulation

Subject

Agent Based Modeling is the most advanced approach for simulating complex systems such as urban mobility, Social phenomena. In such complex systems, the single parts and the whole are often very hard to model [1].

The aim of the thesis is to develop a data mining based approach for the design and validation of complex system simulation. Data mining is used to extract hidden patterns from large collections of data using different techniques. These patterns will be used to model the behavior of the agents. In this case, data mining is used as a guide to build the system model. We can also use data mining to analyze the data obtained as a result of the simulation in order to calibrate the model. Nowadays many data are acquired in real time and thus can be processed online. The main objective of the use of data mining is to shorten the time needed for model building and calibration, in such a way that new data automatically update the model as well as the microscopic simulation.

The approach will be tested on the transportation forecasting problem. In transportation systems, regression analysis and Nash equilibrium are widely used. The proposed Data Mining approach will introduce new techniques from artificial intelligence and machine learning, in order to quickly and automatically build and calibrate the model according to the incoming data. Besides, from multi-agent system point of view, the online data modifies the behavior of agents. Even if, driver behavior is undeniably dependent on macroscopic variables (e.g. routing/traffic flow), microscopic phenomena such as queuing, road shape, signage can also redirect the traffic flows [2,3]. This interaction loop is able to raise some hidden patterns that can be ignored in the current hierarchical approaches in transportation forecasting where the four step macroscopic model gives the transportation demand for microscopic simulation [4].

In this thesis the student uses different data, some coming from mobile devices, from magnetic loop sensors and other from home interview surveys. This allows comparing classical approach with the proposed models. Hence, we can obtain a real-time loop between data extraction and micro-simulation of the transportation by considering different modes. Moreover, the use of actual mobility data during the thesis will make it possible to better construct the approach based on data mining and then identify what is specific to mobility and what can easily be generalized to other areas, such as energy consumption. As a result of the

thesis, the student not only obtains an automatic feedback loop between data and transportation simulation of the current situation and of different scenarios, he also proposes a general approach for many fields where many real-time data are available.

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