

**Project Title:** Integrating Meso- and Micro-simulation Models to Evaluate Traffic Management Strategies

**PIs:** Xuesong Zhou and Pitu Mirchandani– Arizona State University

**Abstract:**

Currently, traffic management strategies such as adaptive control and ramp metering systems go through the following steps: (i) conceptualization of strategies, (ii) development of logic and software algorithms, (iii) simulation-based testing of the strategies, (iv) hardware implementation, (v) field testing of hardware/software systems, (vi) operational testing of the proposed systems, (vii) implementation and evaluation of the system. The simulation testing done in step (iii), when performed, is conducted using models based in one of the several off-the-shelf-simulation packages such as VISSIM [1,2], CORSIM [3], AIMSUN [4] etc. Such models and simulation testing have been quite successful for isolated intersections and single intersections, and small networks with 1-3 intersections – where the effect of re-routing due to incidents, major events that result in changes in traffic patterns have none or only simple impacts on the simulations.

Meso-models that simulate small to large networks, on the other hand, are used mostly at a planning level to evaluate long-term impacts of network wide transportation decisions and management strategies such as network changes (e.g. adding a lane), managed lanes, congestion pricing, dynamic messages, etc. Simulation based “Dynamic Traffic Assignment” (DTA) are typical of such models – where planners input traffic demand in terms of time-dependent Origin-Destination travel demands, and the models outputs traffic conditions, usually at the time resolution of hourly traffic conditions each day of the week [5,6]. Some simulation based DTA models are being used in USA and elsewhere. It should be noted that meso simulation traffic is really a spatial-temporal approximation of micro-simulation traffic – time steps in meso is in terms of 6 seconds, or 10 seconds, or in minutes whereas in micro they are in seconds or
tenths of seconds; spatial resolution is in terms of roads segments and tenths of miles in meso whereas in micro one refers to vehicles in lanes and spaces in fractions of feet.

The integration of micro-and macro- models has been attempted before, but the integration is not as seamless as it should be. Results of a macro model are sent “down” to the micro-model to provide travel demand, usually in a straightforward manner, but the results of the micro-model are not easily sent “up” to the macro model. Still this is very much needed, especially in the testing of Dynamic Mobility Applications (DMA) that are envisioned due to connected vehicle technologies [11], and Active Traffic and Demand Management (ATDM) strategies [12], multiple resolution in space and time is required. In this project, we will consider two such applications: Proactive Multimodal Traffic Signal Control (PMTSC) and Multimodal Adaptive Ramp Metering (MARM).

The signal control algorithms require data with time and space resolution of feet and seconds and while the optimization objectives require the prediction of traffic through the intersections over several minutes and even over hours. As with PMTSC, MARM algorithms require data with time and space resolution of feet and seconds and while the optimization objectives require the prediction of traffic through the ramps over several minutes and hours. Note that in both PMTSC and MARM, algorithms require prediction of the network conditions and the feedback of the conditions from the controls being developed. Figure 2 shows a schematic diagram of is being proposed. The white box “Network Vehicle Flow Simulator” will be the object of Phase 1 of the research. This will be a truly integrated micro-meso simulator. The other white boxes ATDM strategies and Dynamic Mobility Applications will be tested in Phase 2 of the project.

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1 PMTSC and MARM are applications being developed by the principal investigators and do not appear in the literature
Figure 2: Schematic showing the connections and data flow for testing simulation platform and traffic control and management applications.