Multiscale traffic simulation: a new paradigm

Transportation planners and traffic engineers are required to respond to increasingly complex travel demand and network management mechanisms under increasingly congested road conditions. The requirements placed on modeling software to enable the realistic simulation of larger metropolitan areas have never been greater.

Computational scalability of these models is one obvious challenge, but there are others. “There is the fundamental question of model stability and robustness,” says Michael Mahut, vice president of traffic simulation at INRO. “The typical approach for larger-scale applications has been to adopt two distinct models, microscopic and mesoscopic, in what may be known as a ‘multiresolution’ or ‘hybrid’ approach. The underlying models are distinct and each operates at only one scale. However, model outputs can change substantially depending on where interfaces between the ‘micro/meso’ boundaries are drawn, and the lower fidelity of some mesoscopic models may mean that important details are ignored.”

The multiscale approach

To address these challenges, INRO is introducing a new multiscale traffic simulation model that promises scalability to metropolitan-wide applications while preserving the detail and physics of individual vehicle interactions normally associated with microscopic simulation.

“The innovation here is to modulate the rapid spread of congestion when demand greatly exceeds capacity. This enables us to address scalability within a single unified traffic model and at a consistent level of detail over the entire network.”

The new multiscale traffic simulator provides stable results, even in cases of extreme congestion where demand may be overestimated. In areas where congestion levels are too high, model fidelity automatically mitigates congestion propagation, while always respecting the saturation flow of links, lanes and turning movements. In addition, lane- and turn-based outputs help quantify the model response and alert the analyst to major demand/supply imbalances. These improvements and others will be made available within the Dynameq 4 traffic simulation software.

“Dynameq 4 also introduces parallel computing techniques which, when combined with the continuously adaptive traffic simulation, substantially improve dynamic traffic assignment convergence and reduce model run times,” says Daniel Florian, INRO’s vice president of software. “We’ve also included our technology for visual analytics of large-scale mobility data so that individual vehicles can be animated, analyzed and queried in 3D, and across time even at the metropolitan scale. Taken together, we believe these features will be indispensable to the modeler for effective and reliable simulation of the next generation of metropolitan-scale traffic simulation models.”

Dynameq 4 is intended as a tool for planners and engineers who want to leverage a single, adaptive traffic simulation at a consistent level of detail across the entire network for enhanced scalability with larger geographies, under higher demand and in more congested conditions.