Parallel Execution of Region-Scale Evacuation Traffic Models

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Abstract

Simulation-based planning by emergency management agencies for region-scale evacuation scenarios requires fast execution of large vehicular traffic models. The planning problem is characterized by the need to capture micro behaviors of population as well as the far-reaching dependencies inherent in heavily stressed network conditions spanning wide spatial scales. Parallel execution is, thus, required to sustain the required detail, size and speed. However, few parallel simulators exist for such applications, partly due to the challenges underlying their development. While most existing simulators are limited in size to a few hundred thousand road segment intersections, region-scale scenarios can involve millions of intersections. Moreover, many simulators are based on time-stepped models, which can be computationally inefficient for the purposes of modeling evacuation traffic. We are addressing the speed and scalability problems using a two-fold approach. First, we are developing discrete event models of vehicular traffic that accommodate complex driver behavior, operation of intersection controllers and complex individual trip patterns. Secondly, we are developing new model partitioning methods and applying parallel discrete event simulation techniques to enable efficient parallel execution on high-performance computing platforms. These are being incorporated into a new parallel simulator of discrete event models of transportation networks, called SCATTER, which we are developing in support of large-scale emergency evacuation scenarios. The end goal of this effort is to greatly exceed the current vehicular simulation capabilities, and enable the simulation at unprecedented scales with millions of intersections and vehicles.