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Parallelized Microscopic Traffic Simulation with Dynamic Load Balancing

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Abstract: In order to evaluate transportation policies quantitatively, virtual social experiments using traffic simulators are adequate. In particular, simulators with features of both precision and scalability are preferable for applications to real-world and wide-spread traffic phenomena. In this research, we tried to parallelize a multi-agent-based traffic simulator (ADVENTURE_Mates) and enhance its parallelization performance. In the simulator, a road map is modeled as a graph and cars are modeled as autonomous agents. A car agent acquires information from its circumference (other cars, traffic lights, etc.), makes a decision autonomously, and acts based on the decision. The precision is accomplished by employing a multi-agent system and realistic car behavior models, and the scalability is advanced by parallelization in this research. Since the perceptions of the determinants for decision making of a car agent being driven are limited locally, it is reasonable to partition road network to subnetworks. METIS is utilized as a graph-partitioning tool to minimize edge cuts. The computational cost of a subnetwork in the simulation depends on the number of agents on it. The number of agents is not constant and that causes load imbalance. We tested to give weights to edges dynamically and repartition the road network to improve the imbalance. We show the result of graph partitioning approach with dynamic load balancing and its parallelization performance.

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