

Solving dynamic flow problem using simulation

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April 9, 2008

A simulation is an imitation of the operation of a real-world process or system over the time [1]. Simulation is used to describe and analyse behaviour of a system and to optimize a work of the system. As such a system a transportation network can be considered.

A transportation network G is described by directed graph $G = (V, A)$ consisting of the node set V with a source $s \in V$, a sink (destination) $t \in V$ and the arc set A . Each arc a_{ij} from the set A is characterized by capacity c_{ij} and transit time τ_{ij} on the arc. In a feasible dynamic flow at most f_{ij} units of flow can be transported along arc a_{ij} with each time step. Flow leaving a node v_i at time t reaches node v_j at time moment $t + \tau_{ij}$.

There are some statements of dynamic flow problem in transportation network: maximum dynamic flow problem and quickest dynamic flow problem. Each problem considers a network with one search and one destination. A maximum flow sends from the search to the destination as much flow as possible within a defined time period. A quickest flow sends a specified amount of flow from the search to the destination in the shortest possible time [2]. As it has been shown in [3], the maximum dynamic flow problem can be solved using minimum cost flow algorithm. The quickest dynamic flow problem can be reduced to the maximum dynamic flow problem by binary search. Instead replacement the dynamic problem with a static equivalent and use static optimisation algorithm, we can consider this problem dynamic directly, using simulation.

We investigate discrete dynamic network flow problem using discrete event simulation approach. This approach begins of construction of a simulation model. Discrete sim-

ulation model describes a transportation network with all parameters and considers many state changes. The state variables can change their values only at certain time points and the model states are separated clearly from each other [1]. Discrete event simulation model is defined as one in which the state variables change only at those discrete points in time at which events occur [1]. After construction of simulation model the various experiment can be fulfilled on this model and optimal solution can be found.

A simulation approach solves the same problems as an optimization one, but by another way. Simulation can be very useful especially for solving dynamic problems, also dynamic flow problems.

References

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