Construction of real-time traffic state estimation method of a two-dimensional network by data assimilation

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Keyword: Real-time, Data assimilation, Traffic state estimation, Traffic flow model

This study proposes the real-time traffic state estimation on a two-dimensional network by the state-space model. Conventionally, traffic states have been monitored from observed sensing data. However sensing data normally do not cover an entire study area and hence we may rely on traffic flow model (or other traffic simulation model) to interpolate traffic states on sections without sensing data. This approach is called data assimilation and one of the promising assimilation would be the state-space model composed of measurement and system models.

For the state space model in this study, a cell transmission model (CTM)[1] is used for the system model and probe vehicle data are plugged into the measurement model. The network consists of links and nodes and a link is divided into small cells. The traffic state here is defined as density of a cell, which is forecasted and filtered by the state space model. For the state space model, applications to one-dimensional straight pipe sections (e.g. single link network like the highway) have been found in several previous papers. However, to update the state on a two-dimensional network, we have to consider the route choice of vehicles, which is not required for the one-dimensional problem. Since vehicles in the same cell may have different destinations, the density of a cell has to be known by their destinations so that vehicles in the cell are forwarded toward each of the destinations. Although we need to know density by destinations for each cell, probe data cannot observe destinations of vehicles.

Hence, the whole density in a cell is filtered by the probe measurement and the share by destinations is assumed the same as one before the filtering. The details will be explained in the full paper.

The method is validated using a hypothetical data created by a CTM traffic simulator.

References

[1] Daganzo, C.F., The cell transmission model, part Ⅱ : net-work traffic, Transportation Research Part B : Methodological, vol. 29(2), pp. 79-93 (1995)