A13 motorway simulation study data for the Link Transmission Model with variable fundamental diagrams and initial conditions

Jeroen P.T. van der Gun
Delft University of Technology. P.O. Box 5048, 2600 GA Delft, The Netherlands
E-mail: J.P.T.vanderGun@tudelft.nl

Description

We present input and output data for road traffic simulations of the evening peak of 11 September 2012 on the Dutch A13 motorway from Rotterdam to The Hague. During this peak period, a crash occurs. The dataset is derived from mainline double loop detector data. Traffic demand is disaggregated to origin-destination pairs with estimated split fractions based on differences between consecutive detector locations. This dataset is used for simulations testing the Link Transmission Model with variable fundamental diagrams and initial conditions in Van der Gun et al. (under review) and Van der Gun et al. (2018). These referenced works contain further details about the simulated scenario. In addition to the input data for the simulations, we include the output data from several Link Transmission Model and Cell Transmission Model runs.

Keywords: Link Transmission Model, Cell Transmission Model, Smulders fundamental diagram, traffic control, variable speed limits, dynamic lane management, traffic incidents.

Data files

All data files are comma-separated values (CSV). The first line of each file contains column headers, which also indicate the used units.

nodes.csv

List of nodes in the network. For each node, the file indicates whether it is a normal node or a centroid. In this network, each normal node has conservation of vehicles, and each centroid is only connected to one link. The file also includes x and y coordinates that can be used for visualisation purposes. Finally, it indicates the number of time steps per minute used in the simulations, in two variations: variable time step sizes per node or the same time step size for all nodes.

links.csv

List of uni-directional links in the network. The file describes which nodes the link connects and the link length, which may be larger than the crow-fly distance between the nodes due to the road not being a straight line on the map. The last column indicates the maximum number of cells per link for the Cell Transmission Model, assuming the equal time step size from nodes.csv.

link-control.csv

List of fundamental diagrams used on each link over time. For each link and fundamental diagram start time, the Smulders fundamental diagram is described by the free speed, critical speed, capacity, and jam density. Note the simulation starts at 15:15 and ends at 19:45. For simulations with constant fundamental diagrams, one uses the diagrams from 15:15 together with the time-varying link inflow constraint in the last column.

initial-conditions.csv

Piecewise-parabolic initial conditions of links at simulation start time 15:15, as a set of points consisting of a location, a cumulative number of vehicles, and a second spatial derivative of the cumulative number of vehicles in the segment upstream of the point. Locations are measured within each link separately, with zero being the upstream link end. The cumulative is non-positive so that the initial value at the upstream link end is always zero. The second spatial derivative applies to the piece between the point and the previous point, and is hence marked 'N/A' for the first point of each link.

initial-traffic-composition.csv

The disaggregation by destination of the traffic initially on links at simulation start time 15:15. For each link, it indicates the amount of traffic in the initial condition per possible destination. For convenience, the initial relative densities of each destination-based commodity are assumed to be homogenous over the link. (This is not a requirement of the simulation models, however.) Links with no initial traffic are omitted from this file.

traffic-demand.csv

Dynamic origin-destination table of traffic demand wanting to enter the network between simulation start time 15:15 and simulation end time 19:45. The origin-destination table changes every minute but is constant during each minute. The demand is given per possible origin-destination pair.

simulation-*N*.csv

Simulation results per link. Each row describes a computed solution point, consisting of a link, a location within the link, a time, and a cumulative number of vehicles. When part of the computation, the second spatial derivative of the cumulative number of vehicles upstream of points not on the upstream link end is also included (otherwise 'N/A' is indicated).

There are six files. Each file contains the results of a different simulation. The simulations corresponding to the files are:

1. Link Transmission Model with variable fundamental diagrams and initial conditions, with variable node time steps;
2. Link Transmission Model with fixed fundamental diagrams without initial conditions, with variable node time steps;
3. Cell Transmission Model with variable fundamental diagrams and initial conditions, with equal node time steps and the maximum number of cells per link;
4. Link Transmission Model with variable fundamental diagrams and initial conditions, with equal node time steps;
5. Link Transmission Model with fixed fundamental diagrams without initial conditions, with equal node time steps;
6. Cell Transmission Model with variable fundamental diagrams and initial conditions, with equal node time steps and one cell per link.

The files only include the solution points whose calculation is necessary for the numerical scheme. For the Cell Transmission Model, the solution points form a rectangular space-time grid for each link. The Link Transmission Model only produces regularly-placed solution points on the upstream and downstream link ends and irregularly-placed solution points on the initial condition (including intermediate initial conditions when changing fundamental diagrams).

In all simulations, vertical queues are used to store traffic demand unable to enter their first link. The sizes of these queues can be calculated by comparing the cumulative aggregate demand with the cumulative inflow of the first link after the centroid.

In the Cell Transmission Model simulations, the disaggregation of traffic into destination-based commodities is handled at link level, not at cell level.

References

Van der Gun, J.P.T., A.J. Pel, and B. van Arem. “The Link Transmission Model with variable fundamental diagrams and initial conditions.” *Transportmetrica B: Transport Dynamics*, under review.

Van der Gun, J.P.T., A.J. Pel, and B. van Arem. “The Link Transmission Model with variable fundamental diagrams and initial conditions.” Chap. 5 in *Multimodal Transportation Simulation for Emergencies using the Link Transmission Model*, by J.P.T. van der Gun. Delft, the Netherlands: TRAIL Research School, ISBN 978-90-5584-235-3. PhD dissertation, 2018.