

VACANCY INTERNSHIP PROJECT

We are looking for students interested in carrying out their master thesis project at DAT.Mobility

Traffic state estimation combining big data sources with transport modelling techniques

The increasing availability of data opens the opportunity to gain far better insights in current and historic traffic conditions than before. These insights are of big importance for a better understanding of the transport system as well as to feed policy with information. Relatively new data sources like GSM, GPS and smart card data as well as more traditional data sources like loop detector data and surveys could in combination describe the traffic state on a high detailed level.

Problem description

However, still the available data is not complete, biased, not consistent and are associated with a level of uncertainty. The challenge is to combine and fuse the available data sources in such a way that the traffic state can be estimated for an entire transport system for a specific time interval. An interesting research direction to be able to do this, is the combination of transport modelling techniques with these data sources. A transport model is used to estimate impacts of measures on the transport system. The basis of these models are validated behavioral models and a calibrated model for the current situation for a specific region. In current practice the calibration is mainly done for traditional data sources providing counts on several roadways. However, if we are able to extend the data sources in the calibration phase with the available (big) data sources, the available data sources are combined using the transport modeling techniques, providing a complete, consistent and theoretically sound traffic state estimation. The calibration itself is a bi-level optimization problem in which in the upper level the differences between measurements and model values are minimized and in the lower level a user equilibrium problem is solved. The extension of data sources within this bi-level optimization problem introduces several challenges for example regarding a scalable solution approach, choice of parameters for calibration, weights of various types of measurements and dealing with multiple data sources providing similar types of measurements (e.g. speeds based on GPS versus speeds based on loop detector data).

To this end a prototype has been developed in Matlab combined with OmniTRANS transport planning software. This prototype using a simplified supply model extracted from the assignment model, enables usage of observed link flows, link speeds, route travel times, link states, prior matrices and distribution patterns in the optimization problem, allowing for any type of big data to be incorporated. The prototype currently uses the built-in set of solvers of Matlab and shows promising results on small networks.

Internship assignment

Research focuses on solving this optimization problem in an efficient and scalable way. Various assignments are possible, for example on testing and extending the prototype on the following topics:

1. Increase scalability of the prototype to be able to more quickly test the approach on larger networks. This means that the interface between the assignment model and the simplified supply model and the solver might need to be improved/optimized.
2. Determine the exact mathematical properties of the simplified problem. Determine which optimization methods are most suitable for solving that problem.
3. Find the most suitable solver per combination defined in step 2 from existing open source solver projects (e.g. <https://opensolver.org/> and <https://www.coin-or.org>)
4. Create a showcase demonstrating the approach using HERE data, GSM data, traditional traffic counts and a prior OD demand matrix on an existing strategic urban transport model in the Netherlands (all data can be provided through our company).

Research group / information

DAT.Mobility Deventer / Delft University

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When interested in this internship assignment, please contact Ir. Luuk Brederode (lbrederode@dat.nl, 0627369830)