Analysis of Traffic State Definitions towards the Determination and Evaluation of Traffic Congestion Costs using Floating Car Data

Master‘s Thesis of Amirhossein Roshani Kalkhoran

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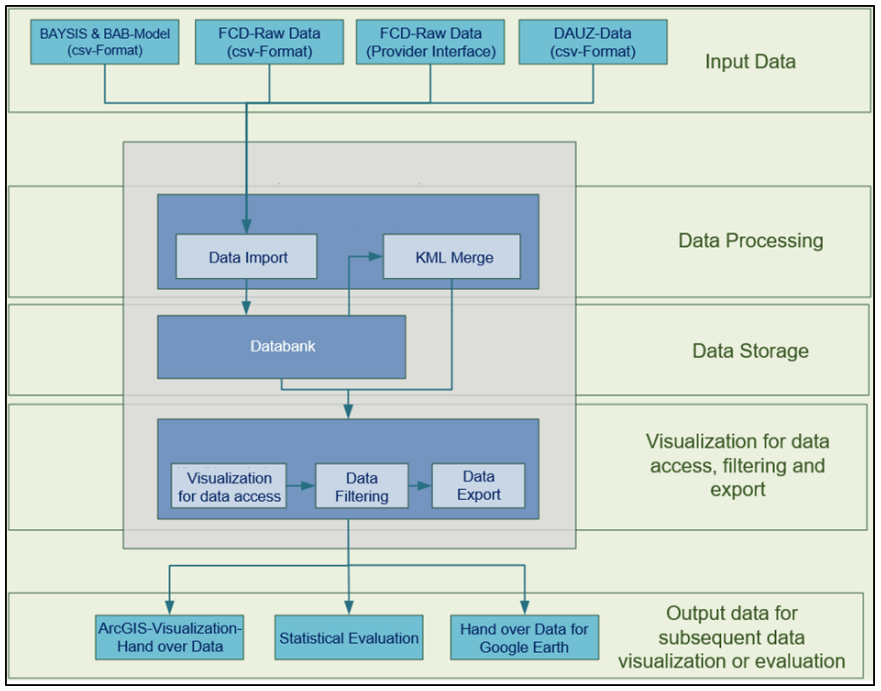


Fig 1. Schematic Representation FCD-Web-Portal

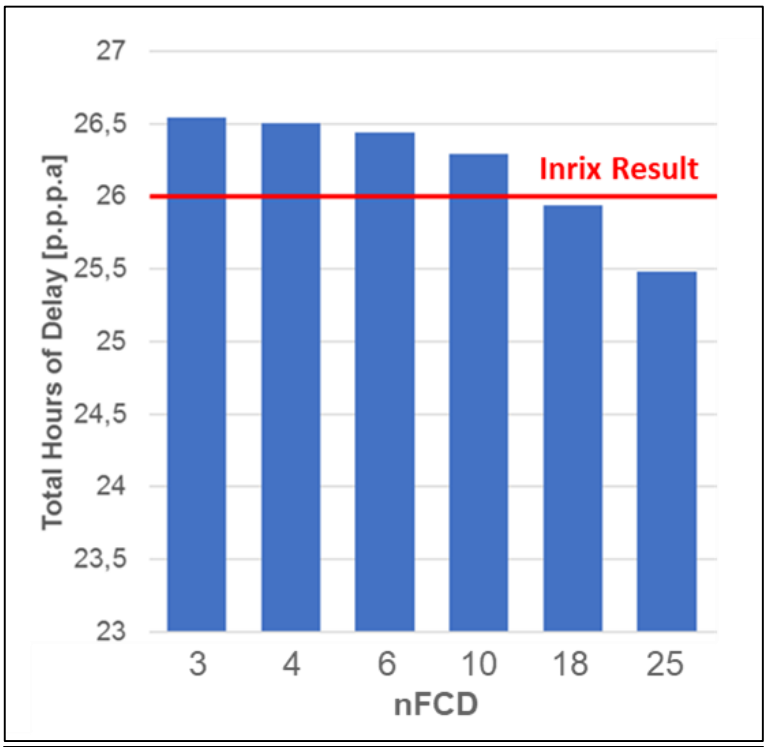
Floating car data (FCD) enriches the potential of classical local detection by transmission of velocity and position of probe vehicles floating in the traffic streams. FCD-Web-Portal, designed and owned by Bavarian Ministry of Housing, Building and Transport, analyzes historical FCDs in Bavarian motorway network. This web portal consists of traffic flow and a congestion analysis tool. The former focuses mostly on time losses and the resulting costs and the latter detects each congestion separately as an event and provides information about the length and duration of each congestion event. There are some parameters to be determined at the start of each simulation: minimum number of FCD in each interval (nFCD), threshold velocity for detection of a congestion (V_c), velocity of passenger cars in free flow ($V_{f,\,PC}$), velocity of heavy vehicles in free flow ($V_{f,\,HV}$). Clear enough, the variation of these input parameters has an impact on the result. Therefore, a sensitivity analysis of the results to the input parameters on three representative motorways with different functionalities in Bavaria (A9: Transit Motorway between Munich and Nuremberg, A93: Regional Motorway between Regensburg and Hof, A99: City Motorway in Munich) was performed. The table on the left-hand side of Figure 2 represents the impacts on time loss. Time loss is calculated when the mean velocity of available FCDs in an interval is less than then pre-determined ($V_{f,\,PC}$). The table on the right-hand side shows the results of the time loss when congestion is recognized. (Mean velocity of FCDs less than V_c)

Impact of input parameters on Time Loss			
	A9	A93	A99
nFCD	2	1	2
V_c	-	-	-
$V_{f,\,PC}$	1	2	1
$V_{f,\,HV}$	3	3	3

Impact of input parameters on Time Loss due to Congestion			
	A9	A93	A99
nFCD	2	1	2
V_c	1	2	1
$V_{f,\,PC}$	3	3	3
$V_{f,\,HV}$	4	4	4

Fig 2. Ranking of the in put parameters regarding their impact on results based on the sensitivity analysis

There are many traffic data providers all around the world, which provide different types of mobility data. Comparison of the results from FCD-Web-Portal and Inrix as one of those data providers on A99, between AK München Ost and AK München Nord showed a perfect match in results in terms of annual hours of delay per driver and mean velocities during both peak hours.



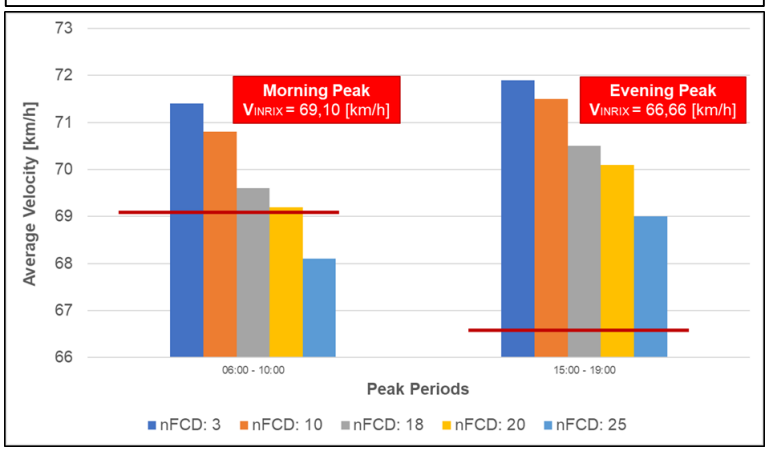


Fig 3. Comparison of FCD-Web-Portal and Inrix data

Results from sensitivity analysis and the comparison of the results from simulations with other traffic data providers lead to determining the optimized input parameters for each of the representative motorways. For V_c, $V_{f,\,PC}$, and $V_{f,\,HV}$ mutual values can be recommended. However, recommendations for nFCD is varying between different motorways. This is attributed to many different factors, most importantly the availability of FCDs on different motorways, the standard deviation of the transmitted velocity in each interval which leads to uncertainties in results. The results showed that the best availability of FCD belongs to A99, followed by A9 and A93. This sequence was repeated in terms of expected errors on these motorways as well.

Setting the input parameters to the optimized parameters resulted in congestion cost of **35,7 Mio. Euro** (A9), **7,1 Mio. Euro** (A93) and **43,0 Mio. Euro** (A99).