

HOW TO EVALUATE PERFORMANCE OF THE ITS ALGORITHMS?

Evaluation of the breakdowns predicting algorithm using a probability approach for traffic management application
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Foundation Problem

Transport congestions caused economic loss of 1 bill. EUR (1% of EU's GDP) in 2007. About 40 000 fatalities were accounted in 2005 in EU; additionally 12% of the overall EU emission budget is coming from road transport. A widely employed tool enhancing traffic situation and mitigating a negative road transport impact is the variable speed limit VSL system, as typical representative of Intelligent Transportation Systems ITS. The problem is the performance evaluation of the newly proposed system that is the crucial point for the stakeholders – whether initiate the act or not.

Example of a VSL installation on highway



Thesis Goals

1. Evaluate the innovative predicting algorithm AIX-ProB that controls VSL. Due to available data, simple before/after analysis is not possible. Considering softness of the problem, the simulation tools do not deliver the deserved results
2. Develop the robust methodology, applicable on the real bulk data. It should be transparent, having the clear results and reflecting the stakeholder needs.

Methodology

Totally 5 performance measures determining the algorithm's quality were developed. They were formed into a SW mean, based on Excel VBA. Additionally, 3D visualization of the traffic situations was provided. The author applied the evaluation algorithm on approximately 180 mil. data records from German and Austrian highways.

Results

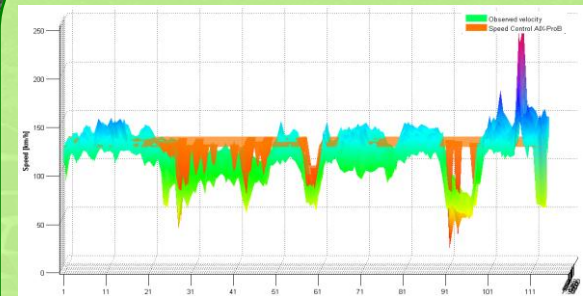
Missing control rate (congestion event occurred but it is not “covered” by speed reduction SR) takes only 4.82% of the whole congestion area size. Critical mismatches (algorithm delivers SR of 30/60 or 80 with no reason) create just 2% from the mismatch budget. Considering these critical SR values, AIX-ProB reached false-alarm rate about 20% with detection rate of 60%.

Highlight of the comparison results, concerning the average values for unfavorable environmental conditions

	AIX-ProB	MARZ
Missing Control Rate [Σ of incidents]	26	142
Mismatch Rate [Σ of incidents]	340	653
False-alarm Rate (false SR of 30 km/h)	6,80%	64,20%

The last part of the results determines a comparison of AIX-ProB (probabilistic) and MARZ (current VSL algorithm dominantly used in Europe, using deterministic approach). The table above express the great limitation of today's practice when MARZ cannot include the actual environmental conditions.

Three Dimensional Visualization



The visualization documents the traffic conditions at the specific highway stretch during the morning peak on May 16 2011. It shows how AIX-ProB (orange surface) proactively delivers the SR values, which copy an actual measured speed values trait in time & spatial extent. This trend points out AIX-ProB's anticipation capabilities.

Thesis Message

Using the real bulk, the author proved the great preventive capabilities of AIX-ProB and generally better results comparing to the currently used algorithm. These results are directly linked to the previous empirical researches, which pointed out the deterministic approach limitations. The author creates SW mean, with use of VBA that evaluates VSL algorithm. Due its robustness, it can be applied even on the other ITS algorithms, e.g. traffic information messages or lane management. The evaluation SW will now initiate the wider ITS deployment by the strategic stakeholders group. Moreover, this tool helps to ITS SW conductors within a product's developmental in order to tailor a solution on the customer needs.