Design, Implementation and Evaluation of an ANPR Measurement Concept on Motorways

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Camera positions and IDs

There are different ways to analyze the impact of a road construction site on traffic parameters such as travel times or traffic volume. This report shows the results of the method: automatic number plate recognition system (ANPR). It demonstrates how the system is installed and which factors can influence the results. The measurement installation covers a 57.2 kilometer long motorway section between Augsburg-West and Ulm-Elchingen. For this segment, travel times are calculated with the help of infrared cameras which recorded number plates and matched them (encoded form due to data privacy) at both measurement stations.

The results of the first measurement in June, 2011 are given separately for each of the driving directions. One direction is heading west from Augsburg, entitled the driving direction to Stuttgart. The opposite direction, heading from Ulm to the east, is named here as the driving direction to Munich.

The positions of the cameras, as well as weather influences during the measurement are explained. The results of the number of detections, matching rate, travel time and travel speed are given on a 15 minute basis for the morning and the afternoon measurement. An average travel time of 30-31 minutes or a travel speed of 114-115 km/h is calculated.

The same analyzing procedure is done for the following measurements in the years 2012 and 2014. The average travel speed for the year 2012 is calculated as 95 km/h and 94 km/h in the year 2014. A difference from the first measurement is the subsequent introduction of a new camera system, which is leads to a higher detection and matching rate. A technological improvement is made by increasing the number of cameras from two at the first measurement, to four during the second and up to eight cameras at the third measurement in 2014. Ongoing improvements on the camera recognition software is leads to higher matching rates.

2014				2012				2011			
Detections [veh]											
STU	←	AUG	34620	STU	←	AUG	36047	STU	←	AUG	16970
ULM	→	MUC	37527	ULM	→	MUC	45408	ULM	→	MUC	25771
Gross gap [sec]											
STU	←	AUG	0:00:02	STU	←	AUG	0:00:05	STU	←	AUG	0:00:09
ULM	→	MUC	0:00:02	ULM	→	MUC	0:00:04	ULM	→	MUC	0:00:06
Matchings [veh]											
STU	←	AUG	4076	STU	←	AUG	2482	STU	←	AUG	1210
ULM	→	MUC	6748	ULM	→	MUC	3891	ULM	→	MUC	3289
Travel time [min]											
STU	←	AUG	35,7	STU	←	AUG	37,1	STU	←	AUG	30,8
ULM	→	MUC	35,3	ULM	→	MUC	35,5	ULM	→	MUC	30,5
Travel speed [km/h]											
STU	←	AUG	96	STU	←	AUG	93	STU	←	AUG	114
ULM	→	MUC	97	ULM	→	MUC	97	ULM	→	MUC	117

Overview of the overall results

Travel speed 2014						
	Augsburg-West→Stuttgart					
	22nd of July, 2014		**23rd of July, 2014**		**24th of July, 2014**	
	AM	PM	AM	PM	AM	PM
ø Travel time [min]	42,6	36,6	35,9	36,7	34,1	36,9
Standard deviation [min]	7,3	2,7	2,8	3,2	0,9	2,4
ø Travel speed [km/h]	**81**	**94**	**96**	**94**	**101**	**93**
	Ulm-Echingen→Munich					
	22nd of July, 2014		**23rd of July, 2014**		**24th of July, 2014**	
	AM	PM	AM	PM	AM	PM
ø Travel time [min]	37,3	35,6	36,2	37,9	36,7	36,3
Standard deviation [min]	2,3	2,7	2,1	5,3	2,3	2,2
ø Travel speed [km/h]	**92**	**96**	**95**	**91**	**93**	**95**
	AUG→STU			**ULM→MUC**		
	AM		PM	AM		PM
Matchings	5235		7567	7213		9566
Validated matchings	4859		6745	6772		8446
ø Travel time [min]	37,5		36,7	36,8		36,6
ø Travel speed [km/h]	**92**		**93**	**93**		**94**

Travel speed 2014

In the results of the measurement 2014, every traffic parameter is calculated separately for each camera device and therefore, the values are given for each driving lane.
The separate calculation for each driving direction and driving lane is particularly important for the last part of the report. It compares only the results of the cameras which are detecting the same lanes over all three measurement years. With the exception of one camera, which does not have the same position as in the previous years (due to road constructions), the results can be compared.
The number of detection, matching rate, travel time and speed are all calculated, as well as the gross time gap as an additional traffic value.
The results show the expected rise of the mean travel speed in the year 2014, from 94 km/h up to 97 km/h. The additional cameras collect travel time data from a high number of heavy duty vehicles which are lowering the average travel speed in the previous calculation.