Implementing traffic simulation models with aerial traffic survey

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Traffic data and human driver behaviours simulation are two of the most important parameters for the proper implementation of a traffic simulation. In our case study, we implemented an innovative method to obtain both a complex set of data of OD matrix and detailed human driver behaviours data in order to set a specific simulation scenario. The dataset used for this case study come from an UAV (unmanned aerial vehicle) survey that took place on a straight 230m segment on the so called Sheffield Road, connecting the cities of Sheffield (UK) and Rotherham. The comparison among different scenarios was implemented by the analysis of the travel times, the real and the simulated ones, that provide an overall measure of vehicles, alone or in a group, driving onto the network.

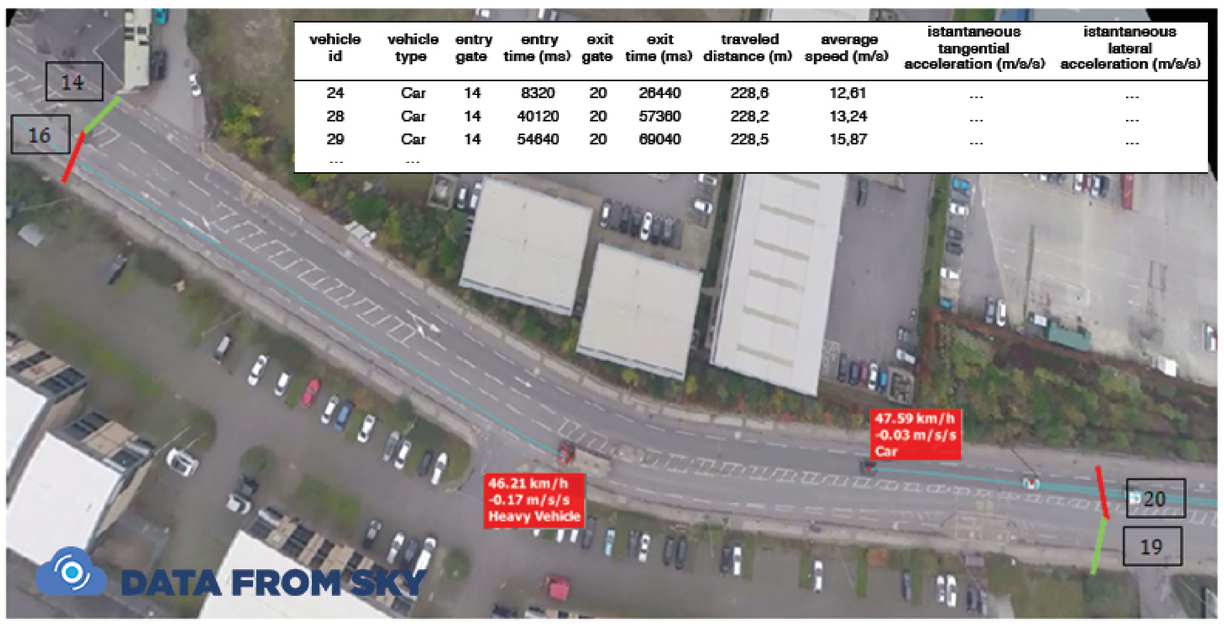
One of the main problem in comparing simulated to real data is the collection of the data themselves. We conducted an advanced traffic analysis of aerial video data using DataFromSky service: it is based on automatic extraction of time-space trajectories of vehicles, resulting in a complete set of traffic parameters supplied to each single detected. The collected data are such as:

- traffic counts at a road section;
- manouvers counts at intersections;
- OD matrix;
- vehicle classification;
- vectorial format trajectories;
- Speed coloured tracks;
- Time to collision
- istantaneous speed;
- lateral and tangential acceleration;
- travel time and travel distance;
- speed profile;
- time gap;
- critical headway;
- follow-up time

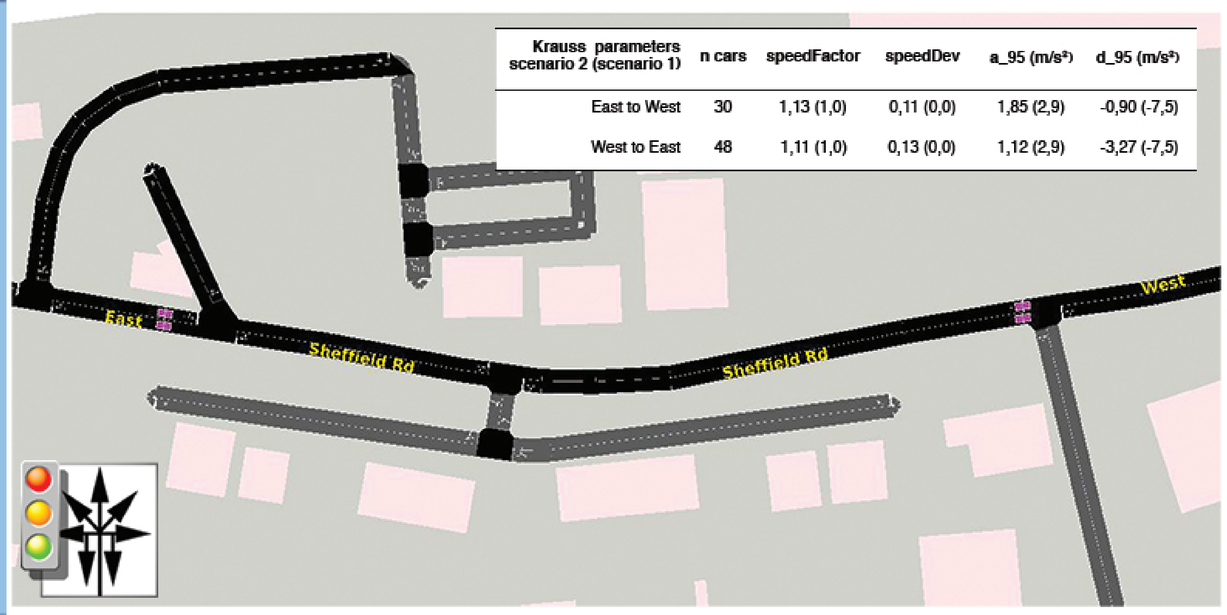
Based on them, it was easily known the actual travel time of each vehicle between the settled gates (***Scenario no.0***).

On the other hand, the entire set of parameters, in particular speed and acceleration, become useful in order to calibrate and implement the behavioural car-following model, the Krauss-modified one (SUMO default).

	n cars	mean_distance (m)	mean_speed (m/s)	Speed_St Dev	85perc_mean_speed (m/s)	mean_traveltime (s)
East to West	30	228,4	13,9	1,46	15,7	16,7
West to East	48	236,0	14,0	1,76	15,4	17,1



vehicle id	vehicle type	entry gate	entry time (ms)	exit gate	exit time (ms)	traveled distance (m)	average speed (m/s)	istantaneous tangential acceleration (m/s/s)	istantaneous lateral acceleration (m/s/s)
24	Car	14	8320	20	26440	228,6	12,61	...	...
28	Car	14	40120	20	57360	228,2	13,24	...	...
29	Car	14	54640	20	69040	228,5	15,87	...	...
...	...								



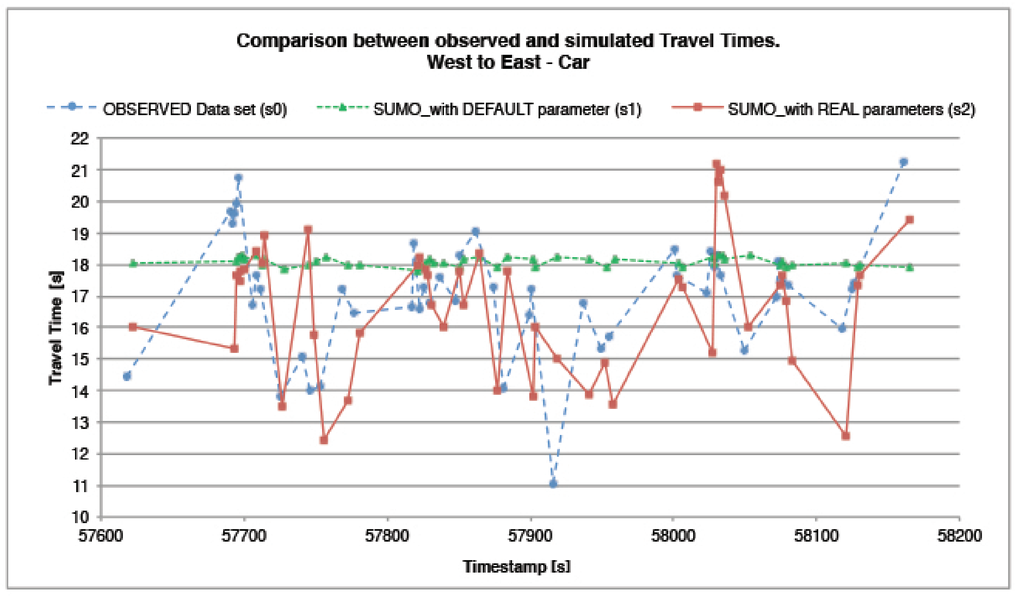
Krauss parameters scenario 2 (scenario 1)	n cars	speedFactor	speedDev	a_95 (m/s²)	d_95 (m/s²)
East to West	30	1,13 (1,0)	0,11 (0,0)	1,85 (2,9)	-0,90 (-7,5)
West to East	48	1,11 (1,0)	0,13 (0,0)	1,12 (2,9)	-3,27 (-7,5)

Two different simulations were developed with SUMO:

- the ***Scenario no.1***, with the default values commonly assigned by SUMO to the 'car' vehicle;
- the ***Scenario no.2***, where the aggregated values got from the DataFromSky analysis were used to better define the vehicle driving behaviour.

In both cases, vehicle were introduced at the beginning of the road at the time corresponding to time recorded data from DataFromSky.

For both considered directions (only one has been displayed), it is clearly visible the greatest similarity of the scenario no.2 to the observed data set's curve. The divergence between their relative mean is limited to 0,13 and 0,28 seconds, whereas the scenario no.1 can't describe with such degree of accuracy the reality of the phenomenon, since the comparison among mean travel times shows much higher values, 1,4s and 1s respectively for the two directions.



Mean travel time (s)	Scenario no.0 (with DataFromSky survey)	Scenario no.1 (with SUMO default values)	Scenario no.2 (with SUMO survey values)
East to West	16,65 (σ=1,76)	18,06 (σ=0,13)	16,52 (σ=2,12)
West to East	17,10 (σ=1,89)	18,09 (σ=0,13)	16,82 (σ=2,13)

The appreciable precision degree achieved through this work represents only a preliminary attempt to implement a commonly used simulation tool in order to better reproduce what is the approach of drivers in a given environment. The upper analysis should increase the size of all the considered variables: a greater network, such as an highway segment, with higher number and types of sampling vehicle and longer lasting survey.