Traffic Light Prediction and Analysis of the Related Data Availability and Usability for Different Types of Traffic Light Assistance Services

Master‘s Thesis of Ioannis Stamatakis

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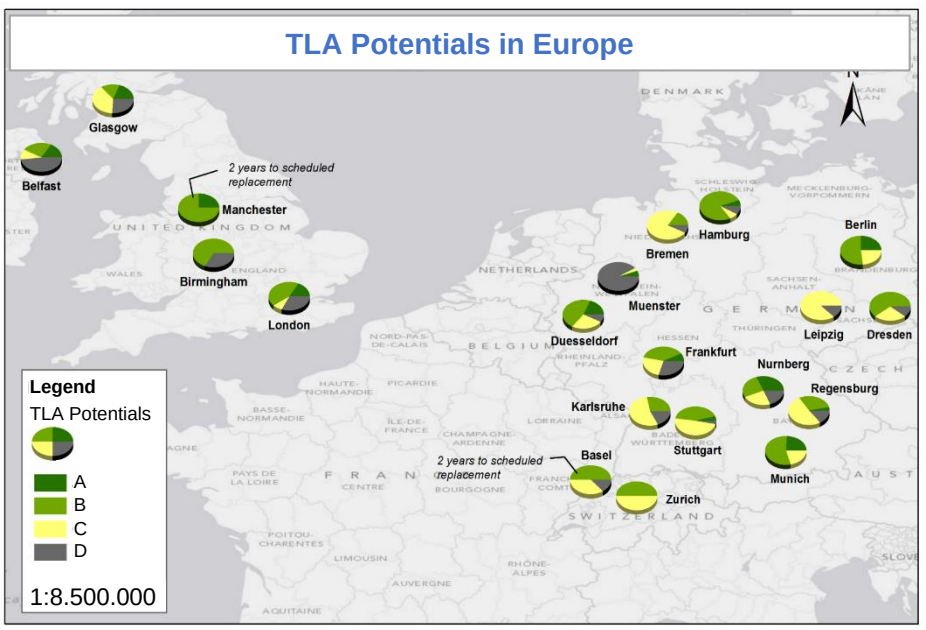
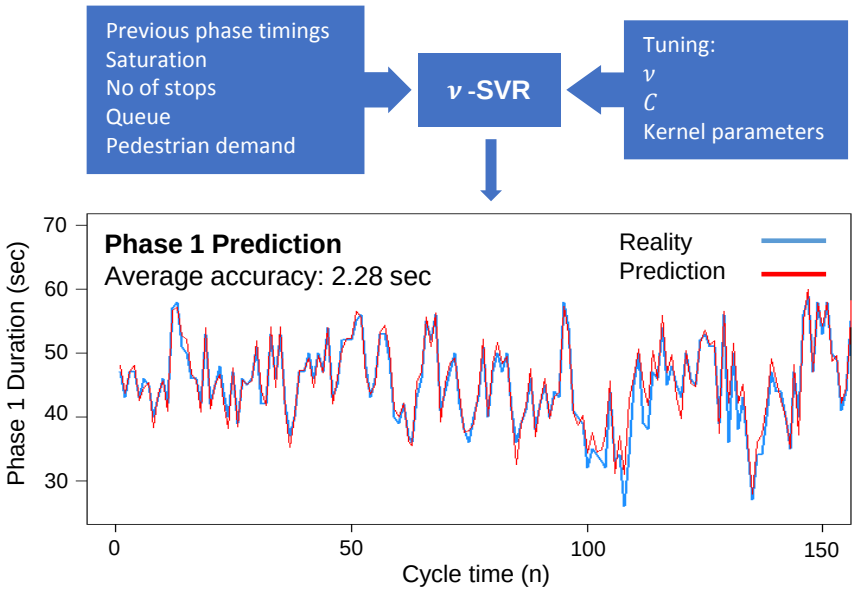
ABSTRACT

During the past years, researchers started focusing on how the vehicles could react to the stop and go moving pattern caused by traffic signals based on recommendation received with the help of Traffic Light Assistant (TLA) applications. The TLA provides the drivers with a look a few seconds in the future offering more safety and comfort to them and more efficiency to the traffic network. The Master's Thesis is divided into two main parts. The first aimed to the investigate the TLA expansion potentials in several markets worldwide, while the second part focused on the traffic signal phase prediction within SCOOT, a highly adaptive model based traffic control system. For this purpose, the discrete time Markov Chains and the ν-Support Vector Regression (ν-SVR) methods were examined, with the last of them giving satisfactory results. The tests took place at a 4-leg intersection of 3 signal phases, at Manchester, UK.

TLA Potentials in Europe



Prediction flowchart



METHODOLOGY

Regarding the survey, a descriptive statistical analysis of the questionnaire's findings was carried out, aiming to unveil up to which extend the different control structures influence the implementation potentials of the different TLA services. For this, the potentials were assigned to four categories, from A to D, reflecting to ideal preconditions, more investigations required and finally to no evidence of potentials respectively.

The ν-SVR applied in the second part of the thesis, aims at finding a function $f(x) = \langle w, x \rangle + b$ which describes at best the actual targets y_i, letting one control the model complexity and training errors through the $\nu \in (0,1]$ parameter. To handle the errors, the points of the dataset are penalized with a cost parameter ($C > 0$), while Kernel functions are used to deal with non-linearity by transforming the dataset into a higher dimension feature space. The input dataset was split into different test periods, as well as different Kernel functions and input data were tested.

RESULTS – CONCLUSIONS

Part I: Survey

A useful overview of the TLA expansion potentials is given, unveiling promising cities/regions. Yet one should look in more depth into the areas of interest.

Part II: Traffic light predictions in SCOOT

With the ν-SVR (using the Gaussian Kernel), predictions of accuracy less than 5 sec were achieved for the main direction and even higher for the secondary one, with a large part of the predictions laying within a -3,+3 sec accuracy interval. The results are considered quite satisfactory given the high adaptability of the system, yet the incorporation of traffic data into the model does not allow the prediction of more than one cycles ahead. Moreover, an "a-priori" error estimation of each unique prediction is not possible, leading to the problem that no decision can be made, whether to transmit a recommendation to the drivers or not.

ν-SVR Results; Comparison of 1 or 2 prior cycles of data