Sustainability Effects of Traffic Management Systems

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Introduction

With the increasing traffic demand on the Belgian road network, the need for a better usage of the existing road infrastructure arises in order to counter the forthcoming congestion. Within this context, our research is aimed at improving the current and future traffic conditions, keeping in mind certain sustainability issues (e.g., environmental effects, capacity throughput, …) that traffic control operators and policy makers propose.

To this end, we investigate the coordinated use of advanced traffic management systems (ATMS). Our methodology is based on three steps: in the first stage, we investigate a wide range of measures, allowing us to exert a certain amount of control on the traffic streams as a whole. The second stage is devoted to characterising the concept of sustainability in a more mathematical setting. The third and final stage considers the evaluation and selection of several different possible control scenarios.

We apply our methodology to a small case study that is representative of the Belgian road network, demonstrating the practical use and feasability of this kind of project.

Applicable control measures

As advanced traffic management systems (ATMS) form the corner stone of our research, we investigate the available operational and planned ATMS that could be used in Belgium. One of our main domains of expertise, lies in the adaptive control of traffic systems by means of on-ramp metering at highways. This technique can be augmented with velocity harmonisation and rerouting directives, resulting in an integrated system of control measures.

Characterising sustainability

Although our research is mainly driven by the fact that we want to optimise an existing traffic system, care should be taken that all relevant parties are satisfied. Indeed, policy makers and traffic control operators sometimes have conflicting points of interest. The innovative aspect of our research, is that all these differences are bundled together into one sustainable cost function (SCF). The SCF takes into account environmental effects such as air pollutions and noise emissions, accident risks, travel times, … all expressed in monetary units.

The most imporant result is that we now have a workable mathematical description of the concept of ‘sustainability’. The SCF not only has its basis on economical grounds, but also on the changing traffic system itself, as we track the changes in the traffic system and relate them back to the cost function.

Controlling the traffic system

Once the possible control measures are known and the sustainable cost function is defined, the next step is to combine them both in a controller. This allows us to steer the traffic system towards an optimal operational point at which the SCF is at a minimum. We thus consider optimising the traffic system equivalent to the minimisation of the sustainable cost function. Several different control scenarios are proposed and evaluated, resulting in a trade-off between on the one hand troughput of the traffic system, and on the other hand a minimum social and environmental impact.