mobil.TUM 2014
International Scientific Conference on Mobility and Transport
Sustainable Mobility in Metropolitan Regions

Munich, May 19 – 20, 2014

Session: Environmental Impacts

Title:

Evaluation of Environmental Impacts of Adaptive Network Signal Controls based on Real Vehicle Trajectories

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Keywords:

Adaptive Network Signal Control, GHG emissions, vehicle trajectories

Abstract:

To improve livability in cities and to meet stringent regulations set by the European Union, municipalities are striving to reduce the amount of green house gas (GHG) and particular matter (PM) emissions. Adaptive Network Signal Control (ANSC) strategies have been developed with the main goal of improving the flow of traffic in urban areas by reducing travel times and the number of stops on the strategic network. However, in addition to improving traffic flow, ANSC strategies could prove to be a useful means for reducing the GHG and PM emissions from traffic in urban areas. In order to test this hypothesis, real trajectory data from test sites in Germany was collected and is analyzed using the EnViVer model (based on VERSIT+) from TNO [Eijk et al., 2011], which takes into account the velocity-time profiles of individual vehicles and estimates the emitted CO_2, NO_x and PM_{10}.
Trajectory data was separately collected within the framework of the two different German research initiatives TRAVOLUTION [Braun et al., 2009] and AMONES [Boltze et al., 2011]. In TRAVOLUTION, a test site for the ANSC BALANCE [Friedrich, 1999] was installed in Ingolstadt. In Hamburg and Bremerhaven, the ANSC systems BALANCE and Motion [Busch and Kruse, 1993] were evaluated within the AMONES project. In both cases, trajectory data was gathered with and without the ANSC system. For each individual vehicle, the extended floating vehicle data (xFVD) - in a temporal resolution of two Hertz – includes the current vehicle speed and acceleration, the gas pedal position, the current gear as well as the engine speed. More than 2000 vehicle trajectories from the three test sites are evaluated. Because GHG and PM emissions are highly dependent on realistic individual driving behavior, the use of field operational test (FOT) driving trajectory data is preferable over traffic simulation data.
The study shows, that ANSC is able to achieve significant reductions in GHG and PM emissions on the strategic network in cities. Due to the change in driving behavior, which can be determined accurately from the data, a change in fuel consumption and thus a reduction of emissions can be observed. The paper examines the correlation between different driving patterns and its effects on the emission of different pollutants.

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