Mathematical models for dynamic eco-driving in signalized intersections in the context of cooperative intelligent transportation systems

Abstract of Doctoral Dissertation – Evangelos Mintsis

This PhD dissertation enhances the human-centered design of existing dynamic eco-driving systems, and models driver adaptation to energy-efficient speed advice upstream of signalized intersections with the use of decision trees and empirical evidence generated via the pilot operation of an advisory dynamic eco-driving system along an urban arterial corridor, quantifies the relevant impacts on emissions, and compares them with the case of automated execution of dynamic eco-driving advice. Moreover, it proposes a simulation framework that is comprised of a microscopic traffic simulator, an external test-bed for emulating dynamic eco-driving, multiple tools for the analysis of simulation output, and a comprehensive set of simulation scenarios for evaluating the performance of different variants of dynamic eco-driving technology.

Results indicate that despite rendering advised deceleration strategies more conservative for enhancing user acceptance and safety, traffic and energy efficiency of dynamic eco-driving are not undermined. Moreover, advisory dynamic eco-driving can yield significant emissions reduction compared to unequipped manually driven vehicles for increased market penetration rate of the relevant technology. However, for multi-vehicle and multi-lane traffic simulation experiments environmental, traffic and safety benefits are maximized when dynamic eco-driving is automated and market penetration rate is maximum. Finally, the implications of this PhD dissertation's results with respect to system design, operational, technological and policy aspects of dynamic eco-driving are discussed.

Keywords: dynamic eco-driving, speed advice, traffic simulation, AIMSUN, emissions, connected vehicle, signalized intersection