# Development of Innovative Methodologies to Support the Design of Connected and Electrified Vehicles

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## 1 Synthesis

In the context of a growing demand for sustainable transportation worldwide, Electrified Vehicles (xEVs) represent a valuable solution to improve efficiency and reduce pollutant emissions of the current vehicle fleet. In parallel with the electrification trend, the synergistic benefits provided by the growing vehicle connectivity level and the exploitation of Artificial Intelligence (AI) techniques may transform the transportation sector in several dimensions with important societal and economic impacts: reduced energy consumption, enhanced traffic flow, and improved road safety are among them. In this framework, it is essential to develop multidisciplinary techniques and algorithms that can assess the increased opportunities for energy-efficient driving with the deployment of connected and electrified vehicles. Therefore, this dissertation constitutes, by means of numerical simulation, a feasibility study on some innovative methodologies to support the design of these types of vehicles, by presenting two relevant case studies and the assessment of some innovative methodologies on them. The first case study is a plug-in Hybrid Electric Vehicle (pHEV): an extensive experimental campaign provided the data used to reverse engineer its control strategy and build its digital twin without having direct access to its EMS. The virtual test rig was then used to assess the theoretical benefits that the introduction of Vehicle-to-Everything (V2X) communication can have in terms of energy and time savings in a real-world route. The vehicle's digital twin was later used to assess the potentialities of an advanced energy management strategy that can exploit V2X information. The second case study is a state-of-the-art mid-size electric SUV: Battery Management System (BMS) data from daily driving were analyzed in order to generate on-the-fly Performance Indicators (PI), that can be easily extracted from real-world driving and charging events and linked to battery health. The results proved that the proposed approaches may be key enablers in supporting the development of connected and electrified vehicles.