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"Sviluppo e sperimentazione di un sistema di ibridizzazione e del relativo sistema di controllo per veicoli convenzionali."

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ABSTRACT

Recently, the possibility of upgrading conventional vehicles to Hybrid Electric Vehicles is gaining interest. Among the different options for hybridization, researchers are focusing on electrification of rear wheels in front-driven vehicles, transforming the vehicle in a Through-The-Road (TTR) parallel HEV.

This thesis deals with the development of an automotive hybridization kit (equipment, along with associated techniques and methodologies), aimed at converting conventional cars into hybrid solar vehicles (Mild-Solar-Hybrid). The main aspect of the projects consists into the integration of state-of-the-art components (in-wheel motors, photovoltaic panels, batteries), and into the development of an optimal controller for the power management.

A prototype of the hybridizing equipment – patented by the University of Salerno (Italy)- is installed on a FIAT Grande Punto. A mild parallel hybrid structure is obtained by substituting/integrating the rear wheels with 7kW in-wheel motors and adding a lithium battery to manage on-board energy. Thus, the vehicle can operate in electric mode (when ICE is switched off or disconnected by the front wheels) or in hybrid mode (when the ICE drives the front wheels and the rear in-wheel motors operate in traction mode or in generation mode, corresponding to a positive or negative torque). The battery can be recharged both by rear wheels, when operating in generation mode, and by photovoltaic panels.

The vehicle is also equipped with an EOBD gate (On Board Diagnostics protocol), which allows accessing data such as pedal position, vehicle speed, engine speed, manifold pressure and other variables. The Vehicle Management Unit (VMU), which is part of the invention and implements control logics compatible with typical drive styles of conventional-car users, receives the data from OBD gate, from battery (SOC estimation) and drives in-wheel motors by properly acting on the electric node. In order to develop an effective and safe control strategy for wheel-motors, a precise real-time knowledge of the Driver Intention is required. In particular, the detection of the active gear is needed.

The thesis, focused on the main aspects of prototype design and realization, also provides insights on control issues related to the integration of the above-mentioned components, drivability and safety.