

# Control Strategy and Application of Ultracapacitors in Hybrid Electric Vehicles

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Production of Hybrid Electric Vehicles (HEV) has been increased dramatically in the recent years. The necessity of finding an appropriate traction source to assist ICE, to build a vehicle with less fuel consumption and air pollutant emission, has been motivated engineers to arise with various configurations of HEVs. One of the main issues of each HEV configuration is determination of the control strategy. Many control strategies has been established and presented in the field of HEVs while they concern about improvement of only one factor more than the others. In this paper the main concern of the control strategy is the fuel consumption. Fuel consumption reduction beside its financial benefits has many other advantages like less pollution and heat generation and efficiency improvement. Although each control strategy shows its best performance in a specific drive cycle, e.g. an urban vehicle demonstrate its best performance in city drive cycles and the overall performance, efficiency and fuel consumption of the vehicle is lower in the other ones, an efficient control strategy should be designed for general driving cycles and considers most of the possible situations a vehicle may encounter with. The most important point of reducing the fuel consumption is to hold the engine operating points in the efficient region.

Ultracapacitors, regarding their physical specifications, are the types of energy storage systems which have ability to deliver the high power and currents. Fast charging, long life cycles, and resistance from high current delivering and capturing make these elements to desired secondary ESS. Defining the hybrid structure with using two types of energy storage systems and proposing its control strategy for different states are presented in this thesis. One of the biggest advantages of HEVs is to ability the regenerate the power in braking times. Using ultracapacitors for regeneration also shows acceptable results in compare with batteries. Regenerative braking efficiency is one of the key points which in battery based on its limitations and charging conditions have encountered some problems; ultracapacitors can be an ideal element for improving the regeneration efficiency.