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GPS Based Energy Management Control for Plug-in Hybrid Vehicles

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ABSTRACT

In 2012 MAHLE Powertrain developed a range-extended electric vehicle (REEV) demonstrator, based on a series hybrid configuration, and uses a battery to store electrical energy from the grid. Once the battery state of charge (SOC) is depleted a gasoline engine (range extender) is activated to provide the energy required to propel the vehicle. As part of the continuing development of this vehicle, MAHLE Powertrain has developed control software which can intelligently manage the use of the battery energy through the combined use of GPS and road topographical data. Advanced knowledge of the route prior to the start of a journey enables the software to calculate the SOC throughout the journey and pre-determine the optimum operating strategy for the range extender to enable best charging efficiency and minimize NVH.

The software can also operate without a pre-determined route being selected. In this case, the software will interrogate a database of previous drive data and select the most likely route being driven. Based on the predicted route the software will then select a suitable charging strategy for best efficiency. The system considers an array of factors to determine the optimum charging strategy such as the driving style of the driver. It is capable of improving upon its own predictions of vehicle energy usage over a series of journeys and aims to produce the most efficient charging strategy. The software has the potential to allow the vehicle to operate 100% electrically in Congestion Charging zones, by pre-emptively charging the battery prior to entering such zones.

This paper presents an overview of the software and strategy developed and shows the energy consumption benefits which this software can provide, based on example drive data for the MAHLE REEV demonstrator, thus further improving the overall fuel consumption of the vehicle and reducing the vehicle emissions.