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A Metric to Evaluate Conventional and Electrified Vehicles in Terms of Customer-Oriented Driving Dynamics

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Abstract : Automobile manufacturers progressively focus on a downsizing strategy to meet the EU's CO2 requirements concerning type-approval consumption cycles. The reduction in naturally aspirated engine power is compensated by increased levels of turbocharging. By downsizing conventional engines, CO2 emissions are reduced. However, it also implicates major challenges regarding longitudinal dynamic characteristics. An example of this circumstance is the delayed turbocharger-induced torque reaction which leads to a partially poor response behavior of the vehicle during acceleration operations. That is why it is important to focus conventional drive train design on real customer driving again. The currently considered dynamic maneuvers like the acceleration time 0-100 km/h discussed by journals and car manufacturers describe longitudinal dynamics experienced by a driver inadequately. For that reason we present the realization and evaluation of a comprehensive proband study. Subjects are provided with different vehicle concepts (electrified vehicles, vehicles with naturally aspired engines and vehicles with different concepts of turbochargers etc.) in order to find out which dynamic criteria are decisive for a subjectively strong acceleration and response behavior of a vehicle. Subsequently, realistic acceleration criteria are derived. By weighing the criteria an evaluation metric is developed to objectify customer-oriented transient dynamics. Fully-electrified vehicles are the benchmark in terms of customer-oriented longitudinal dynamics. The electric machine provides the desired torque almost without delay. This advantage compared to combustion engines is especially noticeable at low engine speeds. In conclusion, we will show the degree to which extent customer-relevant longitudinal dynamics of conventional vehicles can be approximated to electrified vehicle concepts. Therefore, various technical measures (turbocharger concepts, 48V electrical chargers etc.) and drive train designs (e.g. varying the final drive) are presented and evaluated in order to strengthen the vehicle’s customer-relevant transient dynamics. As a rating size the newly developed evaluation metric will be used.

Keywords : 48V, customer-oriented driving dynamics, electric charger, electrified vehicles, vehicle concepts
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