An Example for the use of adaptive methods in powertrain control of heavy duty vehicles

Application of torque control functions for optimized gear shifting

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Abstract

The phenomenon of driveline oscillations is especially present in heavy duty vehicles due to their weight and high transmission ratios. These affect the gear shifting process of automated manual transmissions which can lead to increased shift times. By using the engine torque as input value of a software control function, the oscillations can be influenced in a way that the driveline reaches a defined state before neutral gear is engaged. In this paper a pure feedforward torque control is presented as a robust method to realize this. It is also shown how the control function can be extended by adaptation functions to handle the wide variety of driveline and vehicle configurations in the sector of heavy duty vehicles. The adaptation can be processed using the estimated values of driveline parameters in the control function. Robust identification methods for estimation of driveline parameters during driving operation are presented here. The gear shift process itself can be used as basis for adjusting controller parameters as well. It is presented how this alternative option can be used for iterative parameter adaptation. All functions have been implemented in a prototype ECU and verified through vehicle driving tests.

1. Introduction

The major part of the heavy duty vehicles produced today are equipped with a fully automated powertrain. This includes automated gearbox, automated clutch and automated gear selection. Gearboxes for heavy duty vehicles are mostly automated manual transmissions. Actuators replace the shift levers as well as the clutch pedal. One problem that the automated gear shifting is confronted with is driveline oscillations. These occur due to elasticities in the driveline. The whole driveline consists of various elements of inertia and elasticity and is thus capable to oscillate in various modes [1]. Fig. 1 shows a driveline model with lumped masses.