

OBJECTIFICATION OF SHIFT QUALITY – REQUIREMENT FOR EFFECTIVE TRANSMISSION CALIBRATION

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ABSTRACT

The market share of vehicles with automatically shifting transmissions has increased considerably and will grow in the future. This development comes along with the growing variety of vehicle-engine-transmission combinations and more complex transmission control units. To be able to meet the increasing requirements in terms of transmission calibration, more efficient calibration methods are necessary. Researchers at the Institute of Automotive Engineering (IAE) therefore continuously work on the advancement of objective methods for the evaluation and calibration of shift quality.

One of the main areas of research at the IAE is the objectification of shift quality. In line with the objectification, objectively measurable vehicle signals are combined with the subjective evaluation of the gear change, available as a subjective score. The shift quality comprises shift comfort and shift spontaneity. Objective parameters are calculated from the measured gradient of longitudinal acceleration and transmission input speed, describing shift quality. The objective score models allow automated transmission calibration on the test rig and are a requirement for the elimination of subjective influences on the evaluation of gear changes, which complies with a time and cost efficient calibration process.

Furthermore, an innovative tool, the Shift Quality Assistant (SQA), is based on these objective score models. The SQA as a reliable tool for the efficient evaluation of the shift quality includes know how on objectification obtained and verified at the IAE and supports calibration engineers. A mini-computer, a measurement box with CAN-port and an analogue acceleration sensor are the components of the SQA. After every gear change, the calibration engineer receives acoustic and visual information on the appropriate objective comfort and spontaneity score. The essential advantages of the Shift Quality Assistant include compact design, less expenditure of time and reproducibility of shift evaluations with regard to the calibration of the shift quality of vehicles with automatically shifting transmissions.

For an early start of calibration within the development process independent of hardware, researchers at the IAE develop methods and tools for virtual transmission calibration by means of Software in the Loop (SiL). A detailed vehicle model is used for the virtual transmission calibration to simulate vehicle longitudinal dynamics during gear changes. The crucial submodel for the virtual transmission calibration is a shift sequential control for traction upshifts. An objective evaluation of shift quality is required for the virtual transmission calibration. The optimal control parameter adjustment for corresponding calibrations is determined in an optimisation calculation by means of an empirical model of the shift behaviour. To prove that the new optimisation method works, an existing 7-speed transmission was calibrated on the test rig. A comparison with the series calibration dataset documents that the virtual transmission calibration leads to the desired results.