

Launch Control Optimization of Transmissions with Automated Clutch Engagement

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Dipl.-Ing. Kassem Wehbi

geboren am 25.05.1982 in Kharayeb (Libanon)

Vorsitzender:	Prof. Dr.-Ing. Peter Steinberg
Gutachter:	Prof. Dr.-Ing. habil. Dieter Bestle
Gutachter:	Prof. Dr.-Ing. Burghard Voß

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Berichte aus der Fahrzeugtechnik

Kassem Wehbi

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Abstract

Launch Control Optimization of Transmissions with Automated Clutch Engagement

Keywords: launch control, launch objectives, multi-criteria optimization, vehicle dynamics, automated transmission calibration, robustness

Thanks to the physical principle of a hydraulic torque converter, launch in classic automatic transmissions is automatically smooth. In low-cost transmissions with installed friction clutches, however, the engagement of the clutch has to be controlled by the transmission control unit (TCU) which makes the calibration parameters responsible for the launch quality.

The growing complexity and diversity of modern powertrains increases the calibration effort dramatically, which is why automation of the calibration process for automatic transmissions becomes increasingly important. Through the automated search for optimal values for the launch parameters, the quality of the launch event and the efficiency of the transmission calibration process can be increased significantly.

Therefore, an important aspect of this work is to develop strategies for improving the launch quality as a part of the automated transmission calibration. The concept of numerical optimization has proven to be a promising support tool for the engineer. This requires objectification of the usually subjectively rated launch quality, where the main goal is to achieve a fast and smooth clutch engagement at the same time. Based on these goals, a bi-criterion optimization problem is defined and solved by a multi-objective genetic algorithm. The solution of the problem is not unique but always a set of optimal trade-offs between the two conflicting criteria. Besides, a purely determinism based interpretation of the automated calibration process can only partly meet the requirements of practical application since in reality the properties of technical systems scatter. Therefore, robustness is additionally considered as inherent design goal to generally assure high quality and reliability of launch control.

Kurzfassung

Optimierung des Anfahrvorgangs von Getrieben mit automatisierter Anfahrkupplung

Schlüsselwörter: Anfahrsteuerung, Anfahrkriterien, Mehrkriterien-Optimierung, Fahrzeugdynamik, automatisierte Getriebeapplikation, Robustheit

Aufgrund des physikalischen Prinzips eines hydraulischen Drehmomentenwandlers ist das Anfahren bei klassischen Automatikgetrieben sehr harmonisch. Bei kostengünstigen Getrieben mit eingebauten Reibkupplungen muss jedoch die Kupplung aktiv durch die Getriebesteuereinheit geregelt werden und macht dadurch die Applikationsparameter für die Anfahrqualität verantwortlich.

Die zunehmende Komplexität und Vielfalt moderner Antriebsstränge erhöhen den Applikationsaufwand deutlich, weshalb die Automatisierung des Applikationsprozesses für Automatikgetriebe zunehmend an Bedeutung gewinnt. Durch die automatisierte Suche nach optimalen Lösungen für die Bedatung von Anfahrparametern kann die Qualität des Anfahrvorgangs und die Effizienz des Getriebeapplikationsprozesses erheblich gesteigert werden.

Daher ist ein wesentlicher Aspekt dieser Arbeit, Strategien für die Optimierung der Anfahrqualität als Teil der automatisierten Getriebeapplikation zu entwickeln. Das Konzept der numerischen Optimierung hat sich als vielversprechendes Werkzeug zur Unterstützung des Ingenieurs erwiesen. Dies erfordert eine Objektivierung der üblicherweise subjektiv beurteilten Anfahrqualität, wobei das Hauptziel ist, gleichzeitig ein schnelles und komfortables Anfahrverhalten zu erreichen. Basierend auf diesen Kriterien wird ein bi-kriterielles Optimierungsproblem formuliert und mit Hilfe eines mehrkriteriellen genetischen Algorithmus gelöst. Dabei wird die Widersprüchlichkeit der beiden Kriterien deutlich, weshalb optimale Entwurfsparameter der Getriebesteuerung nicht eindeutig, sondern immer Kompromisslösungen sind. Außerdem kann eine rein auf Determinismus basierende Auslegung den Anforderungen aus der Praxis nur bedingt gerecht werden, da die Eigenschaften technischer Systeme in der Realität streuen. Deshalb wird zusätzlich die Robustheit als wichtiges Entwurfsziel betrachtet, um eine hohe Qualität und Zuverlässigkeit des Anfahrvorgangs unter allen Umständen zu gewährleisten.

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