TITLE: On correlation between steering feel and handling in heavy trucks

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Abstract

Driving a car gives us a certain feeling. Driving another car returns a very different experience. If we could drive with closed eyes, we could nonetheless explain which vehicle it was we were sitting in. Not only are there differences between sports cars and transporters or limousines and trucks but also it is possible to feel the different sensations from driving trucks of different manufacturers. It depends on the seat, the sitting position, the view, the sound, the performance, the brakes - and the steering feel.

There exist many possibilities how to describe a vehicle's steering feel. There are several ISO-standards, such as ISO/TS20119 and ISO14792, that generate characteristic values. There are subjective tests of automotive magazines, and there are opinions of test and race drivers. But exactly there, between the pure objective tests and the subjective impressions that are difficult to describe, presents a gap. This relationship between instrumentally measured numbers and nearly indescribable feelings has not been fully investigated yet. Especially on the question which parameter to change to manipulate the feeling in a certain direction, there is not yet an answer [1].

This paper is on an investigation about finding correlation between instrumental values (values measured by instruments or calculated from those) and non-instrumental values (values obtained by human impressions). The idea is to use drivers as human measuring gauges and let them measure impressions in their own words.

In order to gather anyhow a standardised answer that can be systematically evaluated, a questionnaire was developed, where the characteristic words were chosen corresponding to the results of a double interrogation process.

When people express their feelings like they are accustomed to do, they will utilise a library of expressive words instead of numbers. Thus the measuring results will have that character, too. By using the semantic differential method (also called Kansei-engineering [2]), it can be translated into numbers. The semantic differential method is, especially in psychoacoustics, a well-known method to let people describe how noise sounds to them [3][4]. With this kind of evaluation, a list of parameters comes to existence similar to that containing the instrumental values. But there is also an individual factor that makes people sense differently to others. The dynamics of the driver and the vehicle results from the addition of the vehicle specific dynamic properties (that can be evaluated by ISO-tests) and the driver's experience and skills. This individual factor has to be detected and included in the evaluation. To explore the relation between the
instrumental and non-instrumental values, statistical methods are used.

Previous publications on steering feel focused especially on instrumental values [5]. If they aimed at driver feelings, they focused on the drivers’ responses to fail function e.g. steer-by-wire applications [6] or on the drivers’ feelings rating the haptic impression and grip comfort of the steering wheel material [2].

One restriction of the often-used standardised tests is that they are only valid with the pre-defined conditions (using ideal conditions like flat, dry and clean surface (μ=1), no wind, etc.) [7]. The transferability to other circumstances is limited. For example a certain response from the tire-road-contact to the driver under those idealised circumstances is not as important for the driver as in extreme skidding situations. The tests for this investigation are performed with heavy commercial vehicles that typically roll over on high friction before skidding out.

The long term aim is to understand which parameters of the steering system and chassis (influencing handling properties) influence the driver's steering feel and how they shall be changed to tune the steering feel that best fits the OEM's design purpose.

References


