Chassis systems in the field of NVH and ride & handling performance/

Fahrwerksysteme im Spannungsfeld zwischen NVH und Fahrdynamik-Anforderungen

Forschungsgesellschaft Kraftfahrwesen Aachen mbH
Head of Chassis Department / Leiter Geschäftsbereich Fahrwerk
Dipl.-Ing. Thomas Schrüllkamp
Institut für Kraftfahrwesen Aachen der RWTH Aachen
Steinbachstraße 7, D-52074 Aachen

Driven by globalization, market demands and legislation, the chassis development is constantly improving. The technical innovations in the chassis field are mainly depending on electronic components today. Thus the complexity- and integration level of such new chassis systems is very high. An isolated analysis of the systems in this context is however not sufficient. Considering the specific axle type, the functions must be developed for a combination of systems. This shows particularly effects on the driving dynamics and the acoustic properties of the vehicle.

Resulting from this, vehicle dynamics and acoustic criteria need to be considered during the development process. This paper points out how a knowledge transfer between axle design and NVH assessment can be realized based on mutual analysis methods.

Regarding the axle design, the tire force distribution is essential for ride safety and vehicle dynamics. In general a distinction between under- and oversteering vehicle behavior is made. To achieve a desired vehicle handling, the kinematics and elasto-kinematics of the suspension are designed accordingly. Under normal driving circumstances however, a superposition of different oscillation excitations is caused by e.g. tire imbalance or axle eigenfrequencies. These oscillations are passed on through the entire chassis system, reaching the driver via the steering wheel. Also, steering wheel oscillations can be caused by engine induced rotational excitations. Both types of excitations are influenced by the kinematics and elasto-kinematics of the suspension system.

An investigation of the dynamic axle movements as well as the effective lever arms is necessary for an analysis of these rotational steering wheel oscillations. The basis for the introduced analysis method is the determination of the instantaneous center of motion regarding the tie rod plane. The instantaneous center of motion is the point, around which an object rotates momentarily. With the knowledge of the distance between the instantaneous center of motion and a force line of action as well as the according angular velocity, it is possible to determine the velocity in that direction. The cause of the vibration and therefore of the steering torque oscillation is however a dynamic movement of the instantaneous center of motion.

In addition to the wheel excited oscillations, (engine induced) pressure pulsation of the power steering can also cause excitations of the steering rack.

A sophisticated understanding of the suspension elements can be achieved by the common analysis method for acoustic investigations and the determination of instantaneous center curves. On this basis, sufficient problem solutions can be derived. Also, the effects of active bushings on the vehicle handling and NVH performance become mutually assessable.