Active Kinematics Control: Steering Impulses from the Rear Axle

- Active Kinematics Control (AKC): Toe angle modifications at the rear axle assist steering angle of passenger cars
- Increased driving dynamics and safety
- Integration with other active systems possible
- Electric actuators make the system energy-efficient

Steerable rear axles, which assist the steering angle of the front axle, have been on the automotive industry's agenda for many years. This technology can improve driving safety as well as driving dynamics. Until now, it was too expensive, too complicated or too fuel-inefficient to implement. Meanwhile, ZF has a system that is ready for volume production, which facilitates steering movements of the rear axle by modifying the toe angle. Networking this feature with other active systems on a passenger car brings further advantages.

Track adjustment is an important task when developing the suspension. The overriding aim is to promote optimum vehicle handling because the toe angle on the chassis is responsible, among other things, for directional stability when braking and for the steering precision perceived by the driver. Suspension components such as toe links and control arms ensure that the track setting defined during chassis development on a volume production vehicle is maintained precisely.

However the track setting is not variable—it is at this point that ZF chassis engineers came into the picture. They tested how dynamically adjusting the track affects vehicle handling while on the move. To this end they developed a length-adjustable toe link, which lies at the center of the active system: Electromechanical actuators can vary the toe angle while the vehicle is moving; control software integrated into the vehicle electronics issues the commands. One advantage: A steering movement is produced by modifying the track angle. This is actually small (about three
degrees) compared with the front axle, but steering intervention at the rear axle has a greater impact. Interacting with the steering angle of the front wheels, the result is a distinctly noticeable and positive impact on vehicle handling. This is the principle that underpins AKC.

"The technology delivers benefits in virtually every driving situation," said Dr. Peter Holdmann, head of development at ZF’s Chassis Technology division and in charge of the Chassis Systems business unit. "If you are driving slowly through narrow streets, it steers contrary to the front wheels' steering angle and generates a higher yaw rate of the vehicle." The turning circle is then reduced by up to 10 percent, thus making passenger cars easier to maneuver. "At higher speeds, in other words from around 60 km/h, the system steers the rear wheels in the same direction as the front wheels, thus improving directional stability and driving dynamics," Holdmann stated.

Steering assistance with AKC is created by electromechanical actuators which are not mechanically connected to the steering wheel. It is therefore a pure 'by-wire' system. This has the advantage that AKC can be integrated into the active control network of the particular passenger car. Then it assists the functions provided by other active systems – such as in combination with ESP. If you network AKC and the antilock braking system, stabilizing interventions of the brakes and rear axle improve the vehicle’s handling during deceleration. Thus the system enhances safety and driving dynamics at the same time. When braking on surfaces with varying grip, the stopping distance is reduced. Therefore AKC is also an ideal add-on for ZF’s active systems, such as the Continuous Damping Control (CDC) adaptive damping system. This system adapts the suspension stiffness to the driving situation in real time, thus ensuring better contact between the tires and the road.

Depending on requirements and available installation space, ZF supplies the AKC system, which operates efficiently according to the power-on-demand principle, with an actuator in the center of
the rear axle, also called a "central actuator" system, or with one actuator per rear wheel.

Captions:
1. With Active Kinematics Control (AKC), electromechanical actuators on the rear axle provide a steering angle of three degrees and more. This steering assistance provided by the rear axle substantially increases driving dynamics, driving and ride comfort.
2. The AKC principle: Active Kinematics Control provides various responses depending on the road speed—to increase passenger car maneuverability and driving dynamics.

Photos: ZF

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ZF is a worldwide leading technology company in driveline and chassis technology with 122 production companies in 26 countries. In 2014, the Group will presumably achieve a sales figure of more than €18 billion with about 72,000 employees. In order to continue to be successful with innovative products, ZF annually invests about 5 percent of its sales (2014: around €890 million) in research and development. ZF is one of the ten largest automotive suppliers worldwide.

In 2015, the company will celebrate its centennial. Originally named Zahnradfabrik GmbH, ZF was founded in Friedrichshafen in 1915 by Luftschiffbau Zeppelin GmbH among others. In its early years, the company developed, tested and manufactured aircraft transmissions. After 1919, the company's focus shifted to the automotive and commercial vehicle industry under Alfred Graf von Soden-Fraunhofen, the first general manager and later head of the company. In this sector, the company registered numerous patents for
innovative transmission technology and established itself once and for all as a major technology supplier. ZF grew outside of Europe in 1958 with a location in Brazil, launching a globalization drive that still continues. In addition, through product innovations and acquisitions, ZF constantly expanded its range of expertise. In 1984, ZF acquired the majority share in Lemförder Metallwaren & Co. KG, a move that extended the product portfolio to include chassis technology. In 2001, ZF took over the former Mannesmann Sachs AG to strengthen its value added product offering with driveline and chassis components. It adopted the current name of ZF Friedrichshafen AG in 1992. Today’s product range includes driveline and chassis technology such as transmissions, driveline and chassis components, as well as complete axle systems and modules. ZF products are used in passenger cars, commercial vehicles, construction and agricultural machinery, rail vehicles and marine applications. The company also focuses on the wind power and electronic components business. In addition, ZF Services represents the company on the international aftermarket. In 2014, ZF announced its intention to acquire U.S. automotive supplier TRW.

The shareholders of ZF Friedrichshafen AG are the Zeppelin Foundation, administered by the City of Friedrichshafen, holding a share of 93.8 percent, and the Dr. Jürgen and Irmgard Ulderup Foundation, Lemförde, with 6.2 percent. "Motion and Mobility,” ZF’s tagline, clearly states the company’s core mission: Right from its foundation, ZF has developed and manufactured innovative products for all people around the globe who want to move things reliably, comfortably and safely all while experiencing the ultimate in efficient mobility. Quality, technological leadership and innovative power have always defined the company’s identity – today as much as ever.

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