The new Steering System of BMW – the Integral-Active-Steering.
Synthesis of Agility and sovereignty.

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Abstract:
The new steering system based on the successfully introduced and awarded Active-Steering supplemented by an all new Integral-Rear-Axle-Steering system. Only the combination of both active steering systems enables totally new degrees of freedom for a perfect chassis application; with the result of an optimal driving performance without any compromise.

Technology:
The Active-Steering consists of a hydraulic assisted rack-and-pinion steering system with an integrated planetary gear (still introduced within the BMW products 1-, 3-, 5-, 6-series and X5). The Active-Steering varies the steering ratio on the front wheels depending on the vehicle velocity. In this way the steering effort will be significantly reduced and applied to a perfect driving performance.

Additionally the system stabilizes the car in critical situations for example during oversteer or braking on different friction levels.

The new Integral-Rear-Axle-Steering is based on newly developed mechatronic actuator which operates directly on the wheel carrier and therefore on the rear wheels.
By using a jackscrew actuator as well as a concentric electric motor, steering angles up top 3 degrees on the rear wheels are possible.

In contrast to the Active-Steering, the Integral-Rear-Axle-Steering not only improves the steering effort but also has a positive impact on the driving characteristics. These effects are measurable by yaw rates, lateral accelerations and attitude angle. The functional logic is implemented within a superordinated function unit, the BMW Integrated-Chassis-Management. The target requirements are transferred as steering angles via Flexray to the actuator ECU’s and then to the actuators on front and rear wheels. The base for the safety concept is derived from the experiences with the Active-Steering development.

**Customer Benefits:**

Within the lower velocities, the Integral-Rear-axle-steering steers the rear wheels in the opposite direction to the front wheels. This leads to a significant enhancement of agility and dynamic. During the higher velocities the rear wheels steer in the same direction to the front wheels. The result is a phase-identical transverse force and lead to a considerable enhancement of driving dynamics, particularly for stability; driving behaviour by steering input and reduced roll angles. In summary, the customer gets a more sovereign driving performance.

The principle behind rear axle steering systems in combination with conventional steering is that they have the disadvantage of an understeer tendency. Furthermore, the steering effort at a higher velocity increases with the result of an inert driving performance resulting in reduced curve willingness.

**Only the combination of the Integral-Rear-Axle-Steering and the Active-Steering enables the compensation of the above mentioned disadvantages**

The additional degrees of freedom enable a perfect application for every driving situation. For example, when driving at a high speed: the additional stability produced by the Integral-Rear-axle steering is overlapped by a more direct steering ratio due to Active-Steering. Therefore, the increased steering effort is reduced, the curve willingness enhanced.
Moreover active control interferences on the steering systems, understeer and oversteer, are able to stabilise the car significantly. The control functions from the braking control system DSC are significantly reduced. Additionally, Integral-Active-Steering increases the active safety too.

The Integral-Active-Steering is a meaningful extension of the Active-Steering by the Integral-Rear-Axle-Steering. In combination with the Integrated-Chassis-Management, the new system has lead to a precise steering behaviour without any compromise in every driving situation.

**FISITA 2008:**

The new Integral-Active-Steering will be published for the first time on the FISITA 2008 for a technology interested audience. Besides from technology and functions, a implementation strategy within the BMW products will be presented on FISITA 2008.

Due to the strong connection to an additional abstract of BMW, the Integrated-Chassis-Management, a logic presentation could make sense. In our point of view a connected presentation would be helpful.

**Key points:**

- Technology of the all new Integral-Rear-Axle-Steering
- Technical description of the integration claim from Hardware, Software and functions
- Customer benefits
- Implementation strategy for BMW

Martin Schuster