

Intervention and Driver Control

Consider the Consumer!



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“The Safety of Steel From Pedal to Wheel”

Ford Model B Ad 1928

- **Technical Aspects**
- **Emotional Aspects**

Today's Challenges

- Deal with:
 - Technical Aspects
 - Emotional Aspects
 - Driver Reactions/Over-Reactions
 - Regulatory Aspects
 - Competitive Aspects
 - Financial Aspects
 - Historical Aspects
 - Environmental Aspects

The ABS “Challenges”

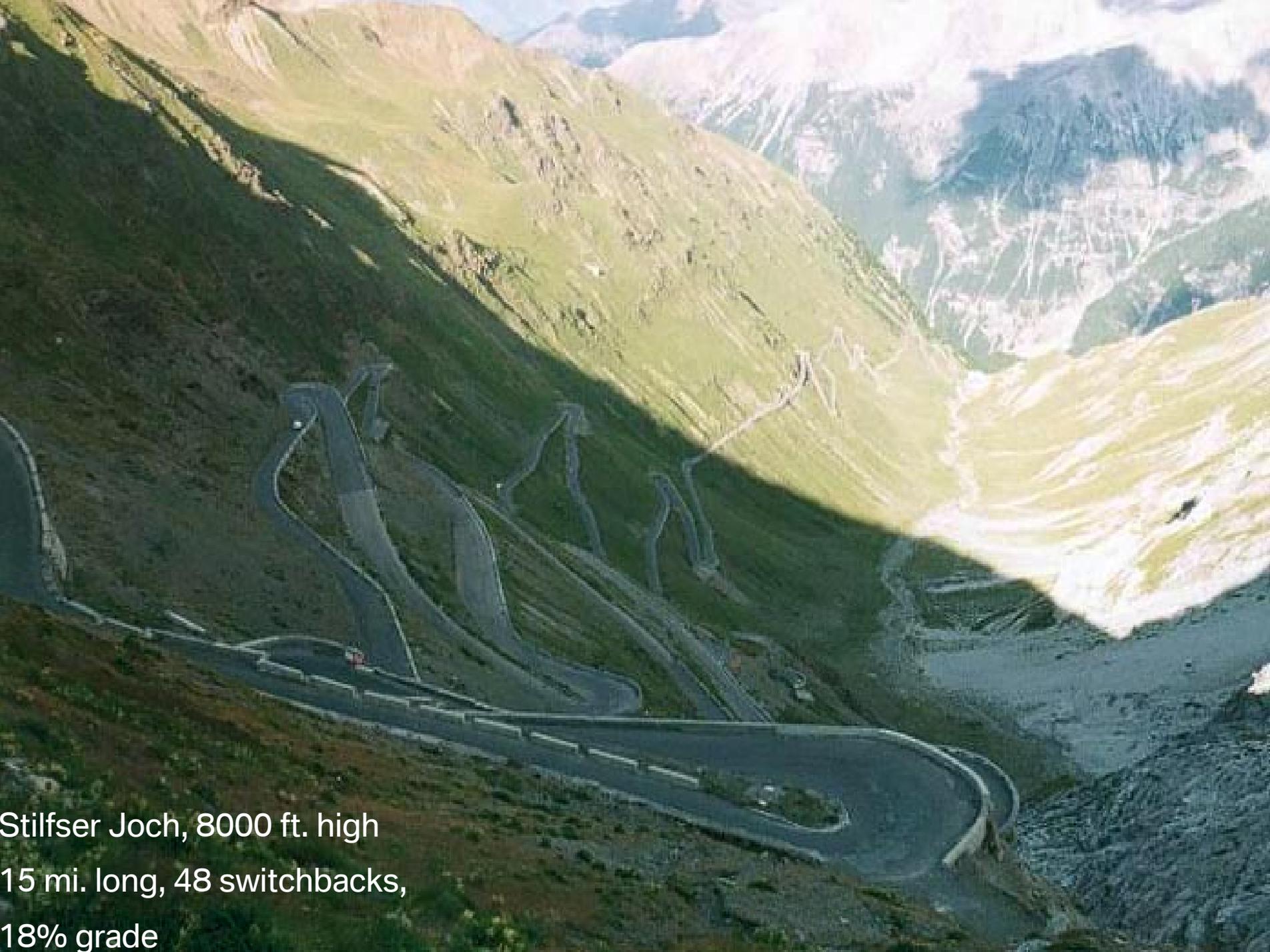
- *AAA Foundation for Traffic Safety website FAQ*
- **Q: Are you saying that ABS is dangerous?**
- **A:** Only when used improperly. As was noted in a November, 1996 report by the Insurance Institute for Highway Safety:
 - “In short, antilock brakes have had mixed effects on fatal crash involvement. The risk of colliding with and killing bicyclists, pedestrians, or other motorists is lower for ABS-equipped cars than for cars without ABS. This is in accord with the theoretical ability of drivers of ABS-equipped cars to steer around obstacles in the road during hard braking. However, there has been a corresponding **increase in the risk of crashes fatal to the ABS vehicle occupants** (particularly rollover and run-off-the-road crashes but also some multiple-vehicle crashes).”
- *Quoting Duane Perrin NHTSA*
- “We are finding that a driver tends to jam on the brakes and steer, and in many cases steer quite violently; the driver does not, as popularly believed, jam on the brakes and freeze. ... We hypothesize that in many cases the drivers with ABS would have steered right off the road and into the ditch. “

ABS versus Electronic Stability Control

- ABS...
 - referred to as "dangerous,"
 - "must learn how to use it,"
 - "no benefit"
- ESC...
 - 30 to 67% effective in reducing crashes/fatals [NHTSA]
 - 41 to 56% effective in reducing single vehicle crashes/fatals [IIHS]
 - Enormous potential for saving lives...why not in every vehicle?

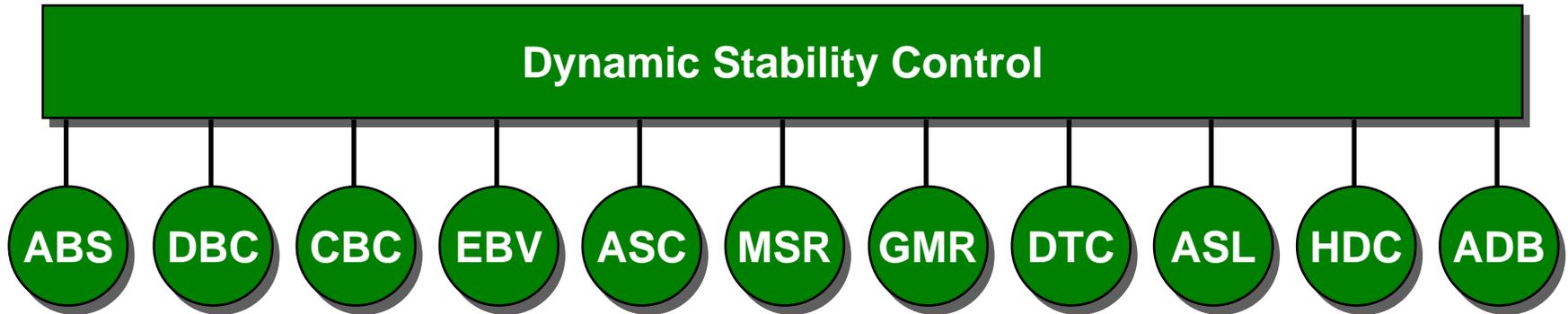
ABS adds more steering ability for the driver to use.
vs. ESC stabilizes with braking intervention.

Consider Extreme Environments



Stilfser Joch, 8000 ft. high
15 mi. long, 48 switchbacks,
18% grade

Functional Systems Involving Stability Control



ABS: Antilock Brake System
DBC: Dynamic Brake Control
CBC: Cornering Brake Control
EBV: Elect. Brake Force Distribution
ASC: Automatic Stability Control
MSR: Engine Braking Control

GMR: Yaw Moment Control
DTC: Dynamic Traction Control
ASL: Trailer Towing Stabilization Logic
HDC: Hill Descent Control
ADB: Automatic Differential Braking

Brakes – Steering – Engine – Transmission - Differential

“Active Steering“

Development Goals

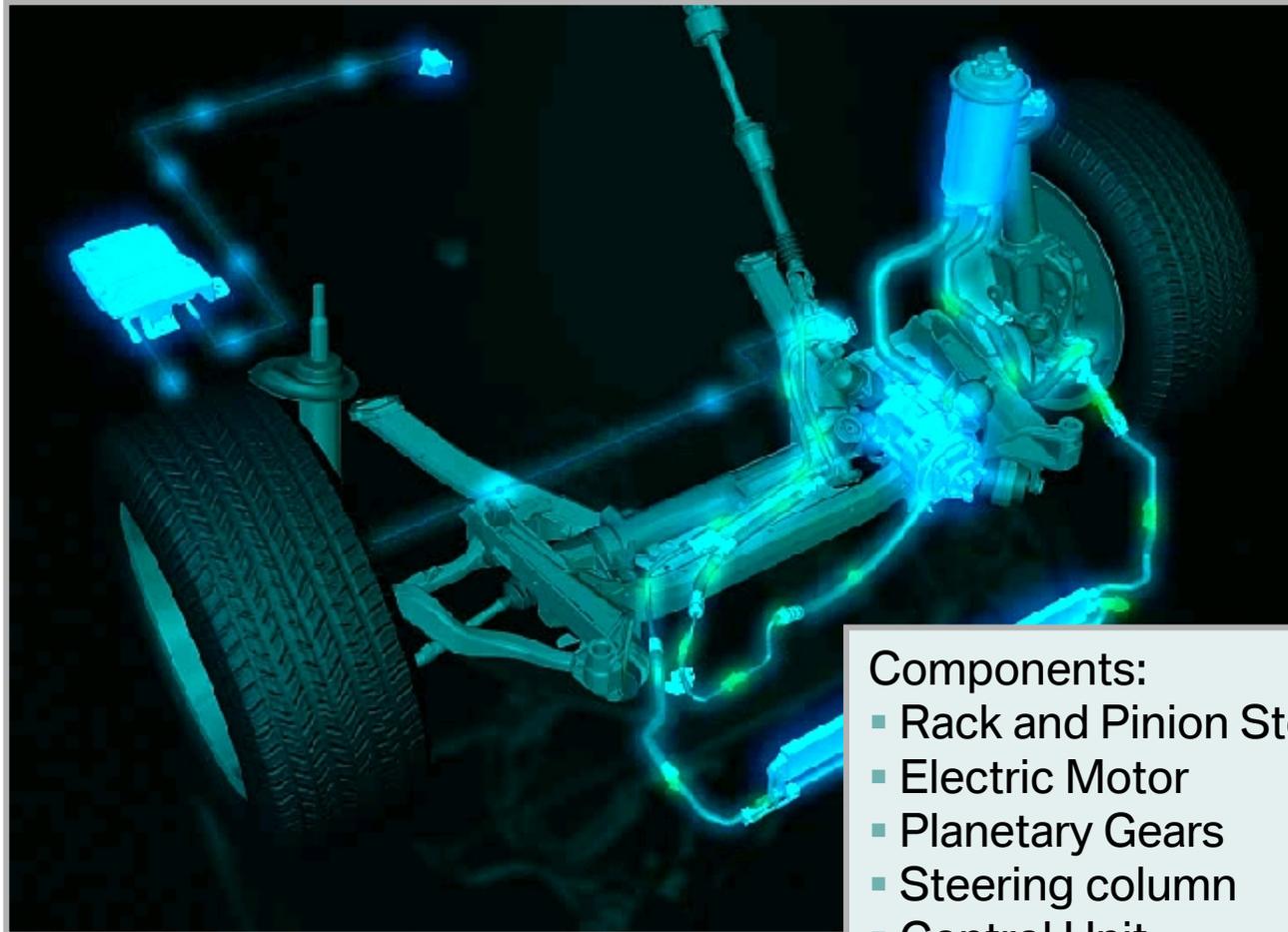
- Conventional steering systems are fully developed; the potential to make major strides in power steering has long past.
- Vehicle performance has been continuously increasing; the conflicting goals between quick reacting cornering and straight-ahead stability are difficult to solve with conventional steering.
- Driving stability via frequent individual wheel braking would be judged to be uncomfortable.
- An electronic-planetary gear system superimposed over the conventional steering gear can combine the advantages of conventional steering with functions of a steer-by-wire system.
- Pure steer-by-wire systems are (still?) perhaps too complex, too expensive, and deliver a synthetic feeling, which makes market acceptance questionable. Emotional Aspect !

Active Steering Capabilities

- Variable Ratio “feel” based on speed
- Constant Effort regardless of speed
- Stabilization Steering via steering intervention
Counter-steer intervention when needed!

System Overview

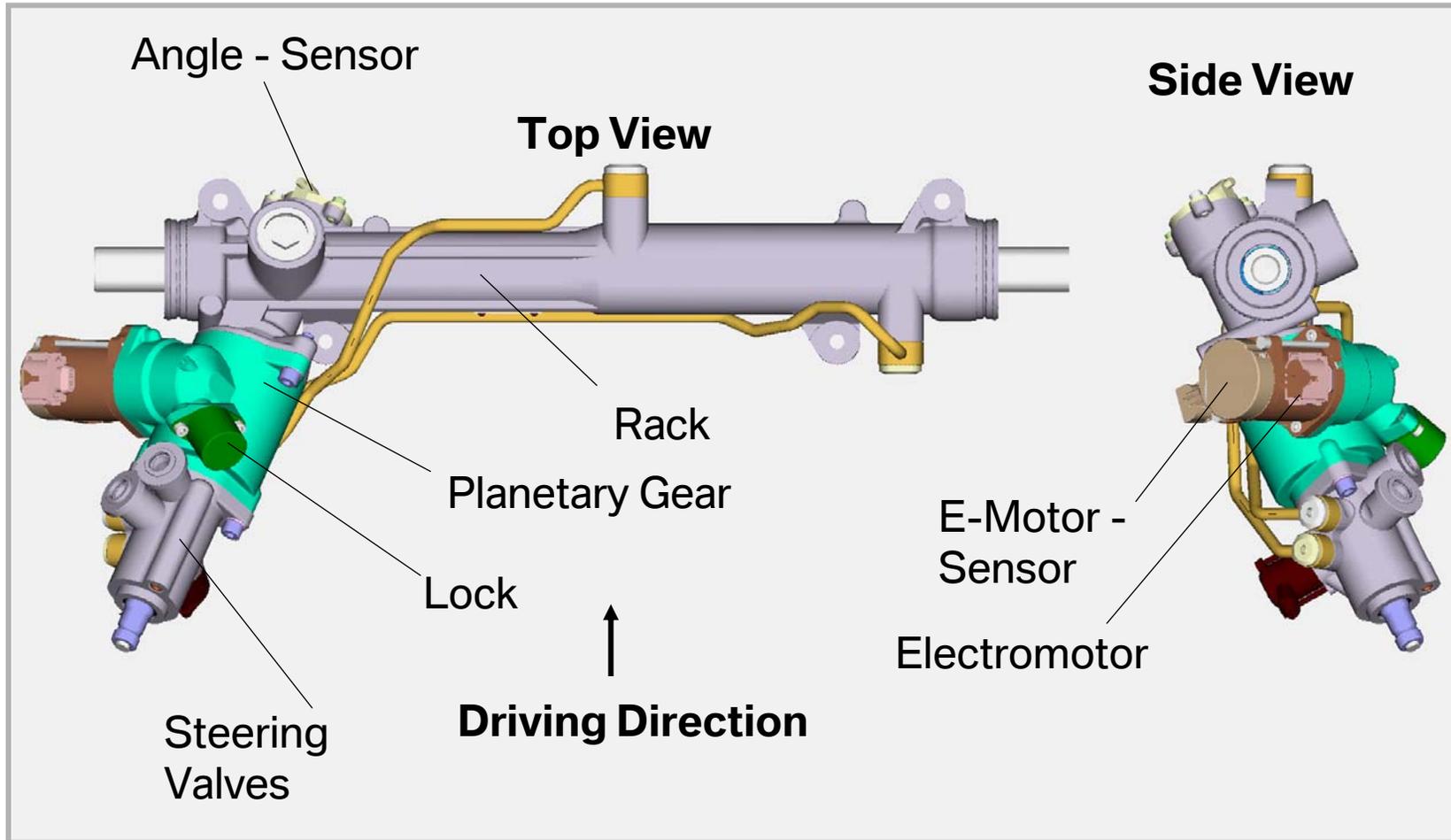
Components of Active Steering



Components:

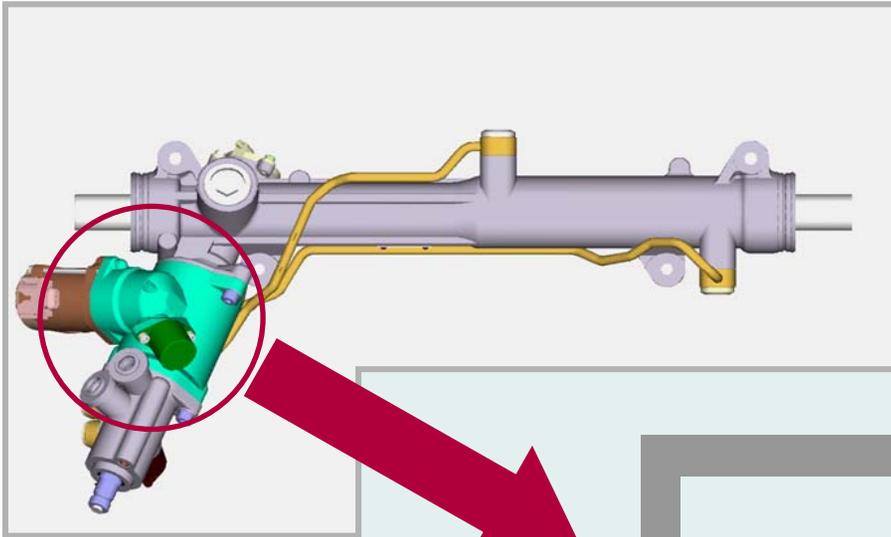
- Rack and Pinion Steering
- Electric Motor
- Planetary Gears
- Steering column
- Control Unit
- Sensor Cluster
- Steering Pump and Reservoir
- Hoses, Fluid Cooler

Mechanical Layout

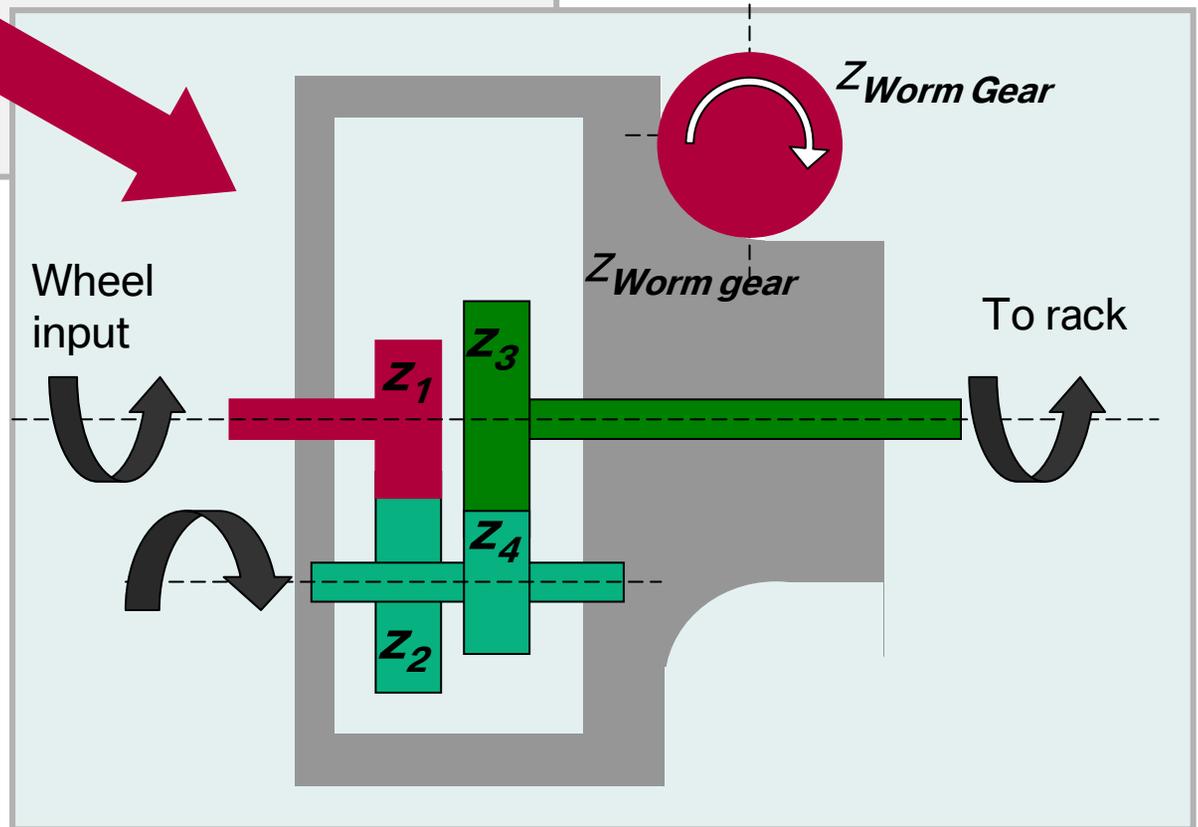


Mechanical Function

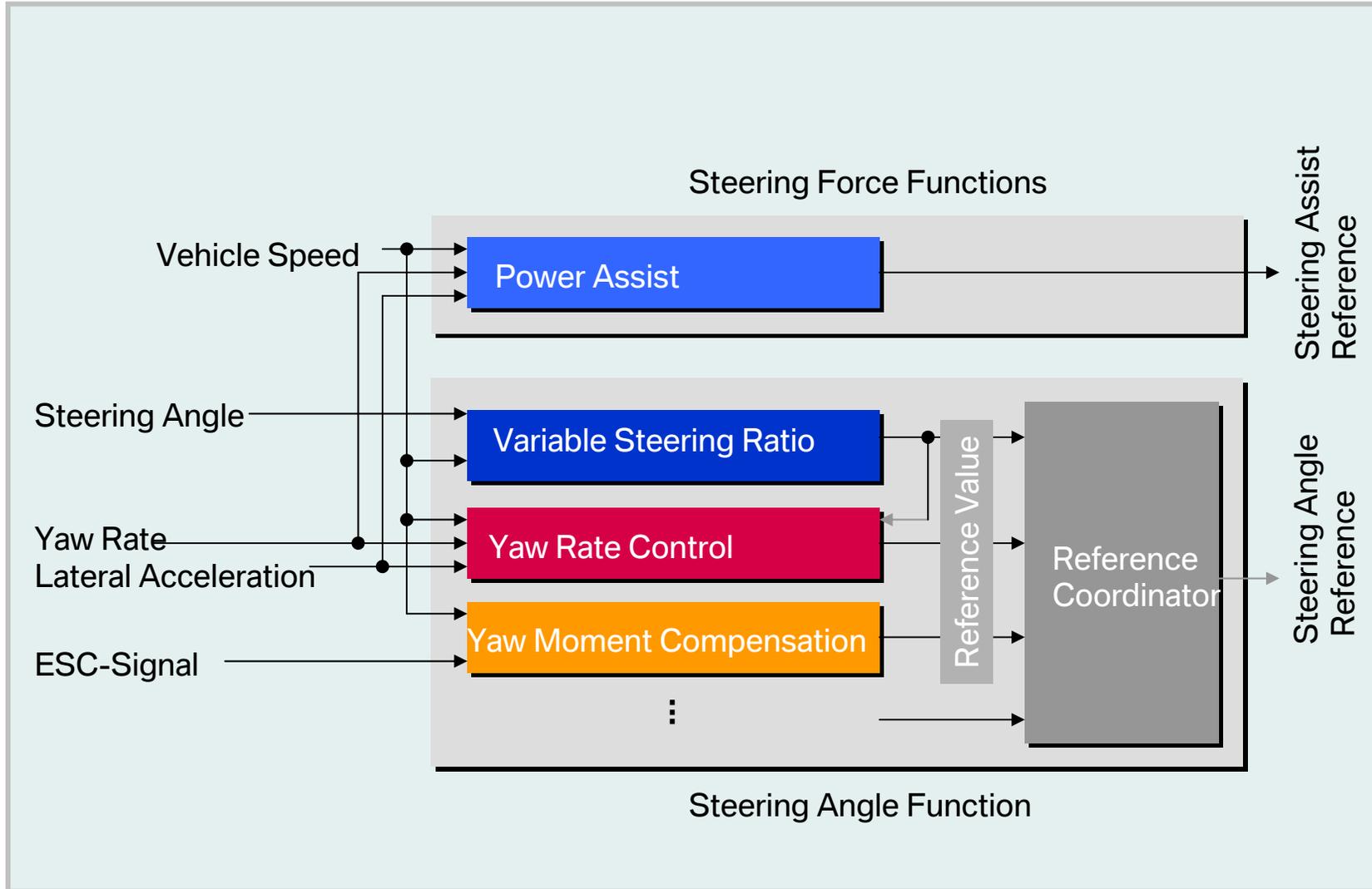
Planetary Gear



- Mechanical steering-train
- Angle addition
- True steering torque
- Inherent fall-back level

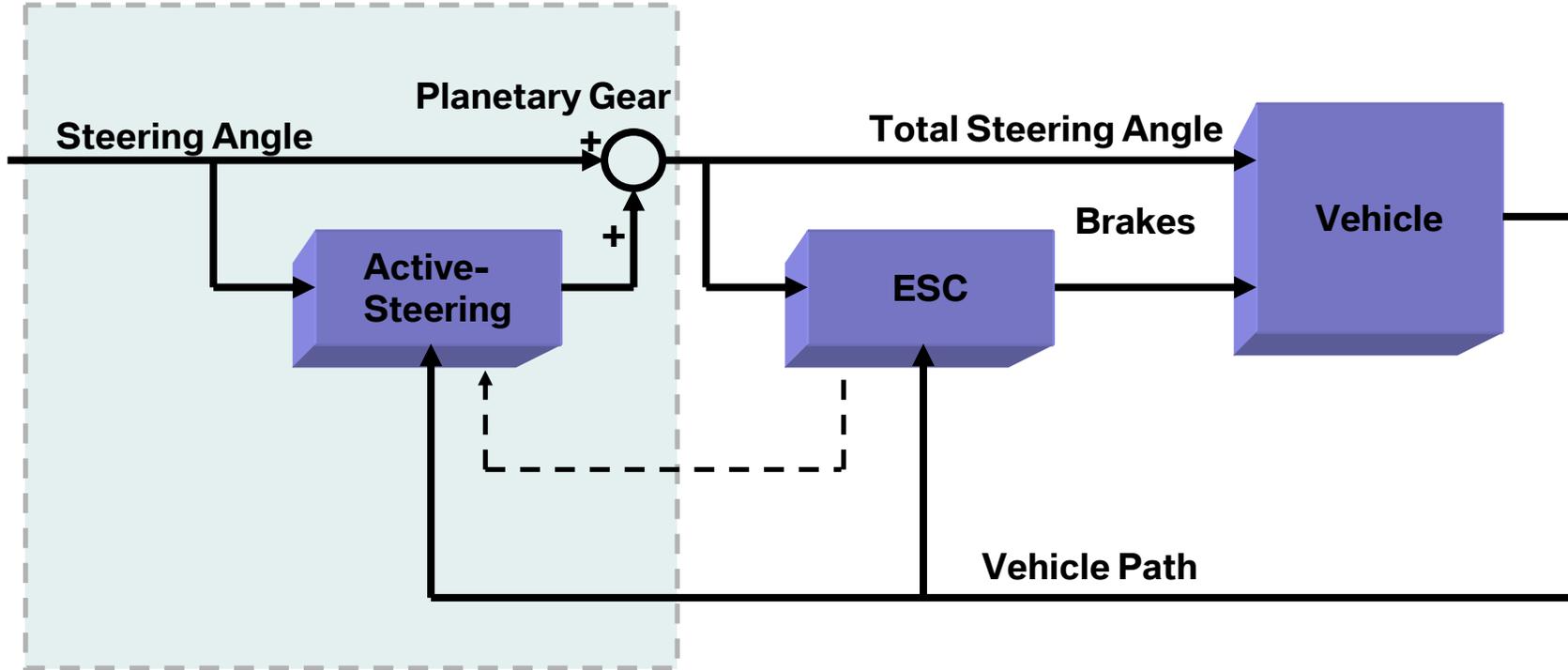


Functional Overview



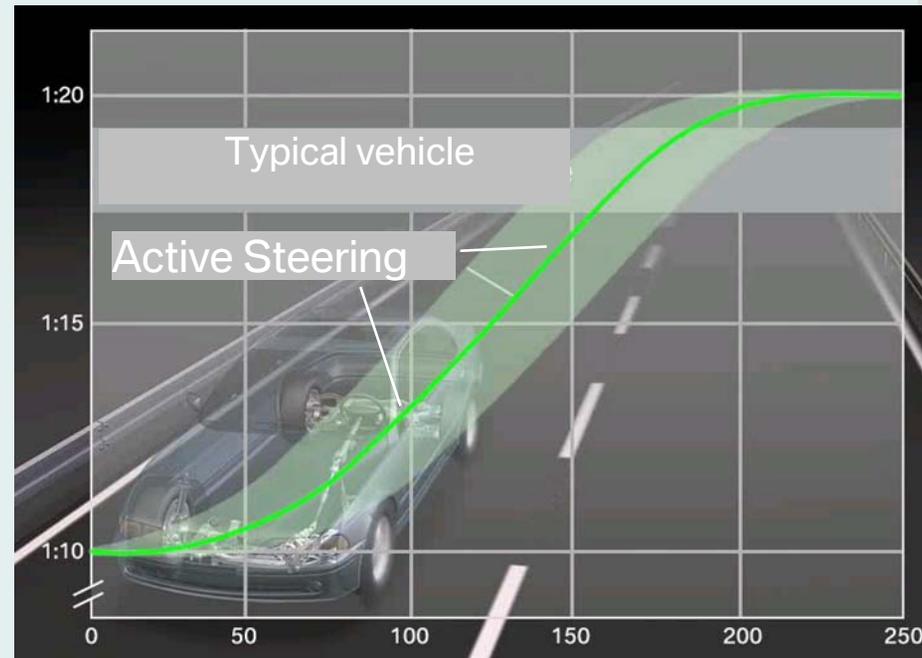
Functional Overview

Integration of Active Steering - ESC.



Functional Overview

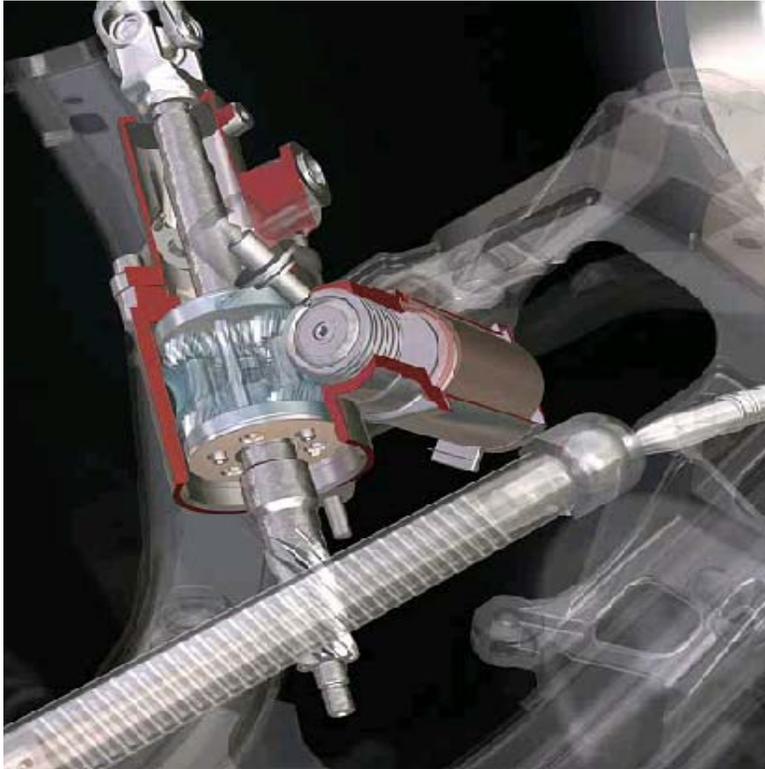
- Steering ratio depending on steering angle and vehicle speed
 - More control and agility at lower and medium speeds.
 - Improved comfort during parking and maneuvering (less rotations).
 - Increased control and security during higher speed maneuvers (hands stay on wheel).
 - More stable straight-ahead tracking at higher speeds.



- Matching of characteristics with consideration for specific vehicle dynamics
 - Carryover of characteristics to other models based on experience
- Connection to steering assist to harmonize ratio and effort

Driver Emotion

The safety of steel from wheel to wheel.



- Anti-reversing action of the worm drive...when E-motor is off, no chance for slack
- Electromagnetic lock that prevents E-motor movement unless activated.
- Automatic braking of the E-motor via short-circuit electronics.

Summary

- With any new active safety system, never forget the effect that driver emotions and reactions might have on how the system performs....or is „perceived“ to perform.
- Advanced systems often need to start out with basic building blocks so “we” should be careful not to overpromise.
- Active Steering is a new system that includes the traditional mechanical connection, with enhanced electronic controls including counter-steer intervention.
- Active Steering can help bridge the gap between the conflicting challenges of straight-line driving stability and quick low speed response.
- Active Steering can offer the consumer all the benefits of steer-by-wire and still offer a mechanical connection to the road.
- With today’s electronics, high quality stability can benefit from balanced use of brakes, steering, and engine controls, etc.

Thank You !

