Bosch Engineering

Vehicle Dynamics Management

Innovations in Vehicle Dynamics Control

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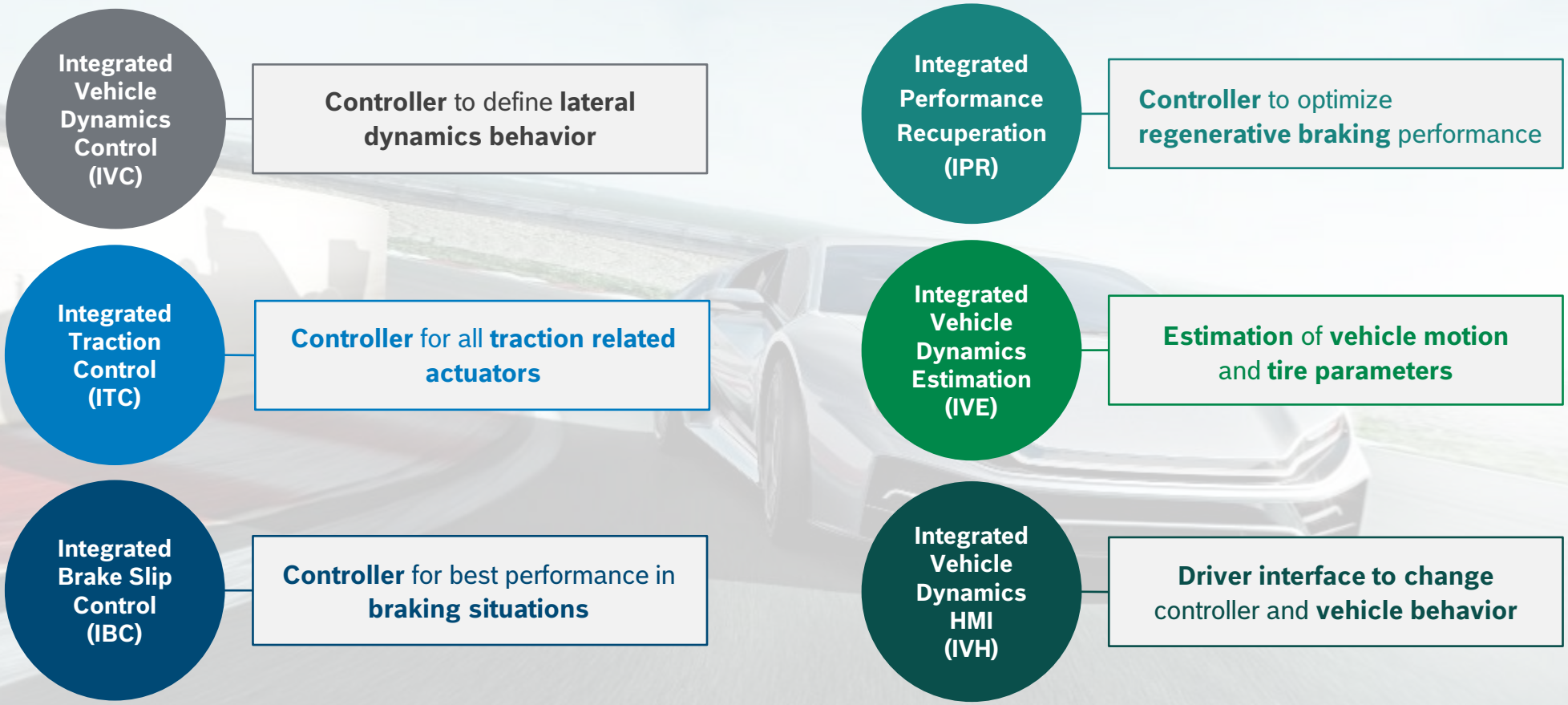
Innovations in Vehicle Dynamics Control

Overview: Vehicle Dynamics Management



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Innovations in Vehicle Dynamics Control
Vehicle Dynamics Management

General Features

Patented Bosch Engineering **approach** allows new level of performance and smoothness in multi actuator vehicle dynamics control

Integrated approach instead of friendly coexistence

Model-based design instead of heuristic approach

Application of **state-of-the-art controller theory** with high amount of **feed forward control**

General Benefits

Enhanced driving **performance**

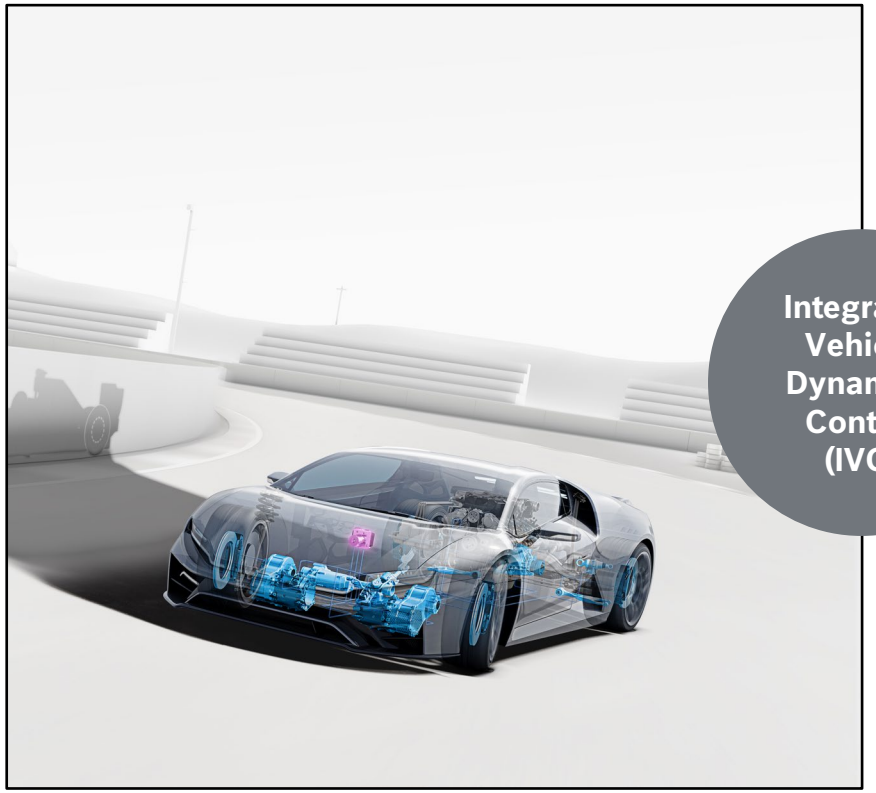
Enhanced driving **safety**

Natural and **reliable driving behavior**

Reduction of platform complexity by resolving of major tuning compromises in suspension setup

Innovations in Vehicle Dynamics Control

Overview: Integrated Vehicle Dynamics Control (IVC)



Integrated Vehicle Dynamics Control (IVC)

- Brake Torque Vectoring
- Electric Torque Vectoring
- Rear Wheel Steering
- Active Front Steering / Steer-by-Wire
- Active Suspension / Active Anti-Roll Bars
- Active Aerodynamics

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Integrated Vehicle Dynamics Control (IVC)

General Features

Adjustment of **steering effort** and **agility**

Optimized balance at the limits of driving dynamics

Increase of **yaw damping** properties

Smoothened stabilizing interventions (compared to standard ESC control)

General Benefits

Increased drive-through speed regarding **press maneuvers** (slalom, lane change)

Improved lap time on racetracks

Lateral dynamics becomes speed, mode and situation dependently **adjustable**

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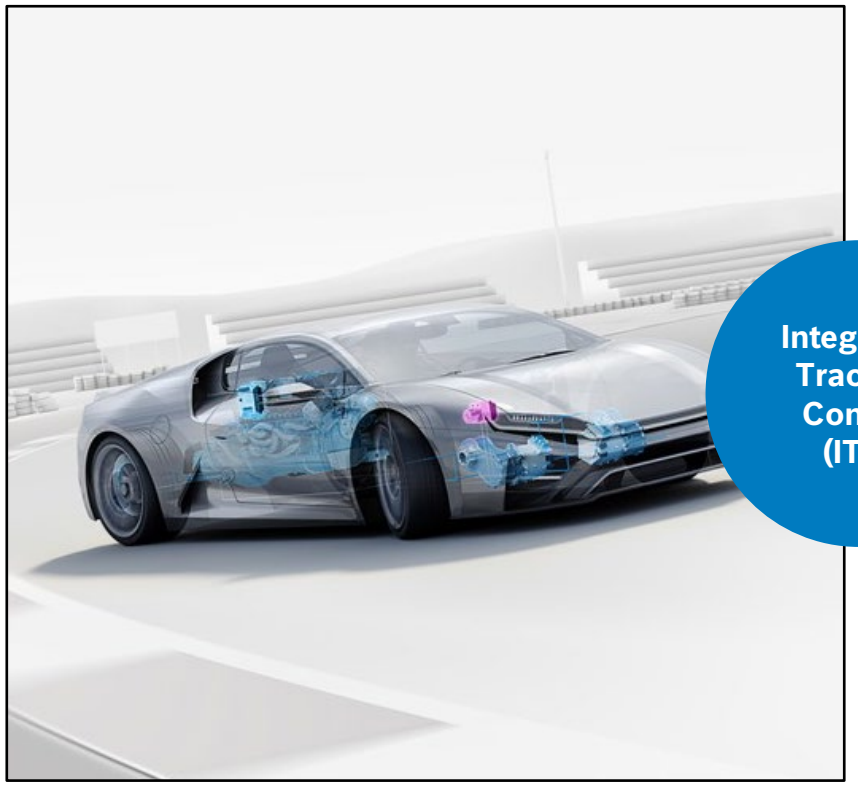
Overview: Integrated Traction Control (ITC)



Integrated Traction Control (ITC)

- Performance Traction Control
- Limited Slip Differential Control
- Center Coupling Control
- Axle-Split Torque Distribution
- Axle-Split / Wheel-Split Traction Control
- Distributed Traction Control

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Integrated Traction Control (ITC)

General Features

- **Integrated** solution of **engine**, **brake**, **limited slip differential** and **center coupling** control
- **Fast** and **smooth** slip control
- **Sideslip angle** control
- **Electric drivetrain** optimized

General Benefits

- **Improved lap times** on racetracks even for experienced drivers
- Not slowing down the car, but **optimizing performance** instead
- Amount of **power oversteer** becomes **adjustable**
- Available as “**distributed**” traction control

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Overview: Integrated Brake Slip Control (IBC)

Integrated Brake Slip Control (IBC)

- Model-based Feedforward Control
- Slip Controller instead Instability Controller
- High Speed ABS
- Improved Corner Brake Control
- Adaptive Measures (Tire, Brake, ...)
- Improved Stopping Distance

Innovations in Vehicle Dynamics Control
Integrated Brake Slip Control (IBC)

General Features

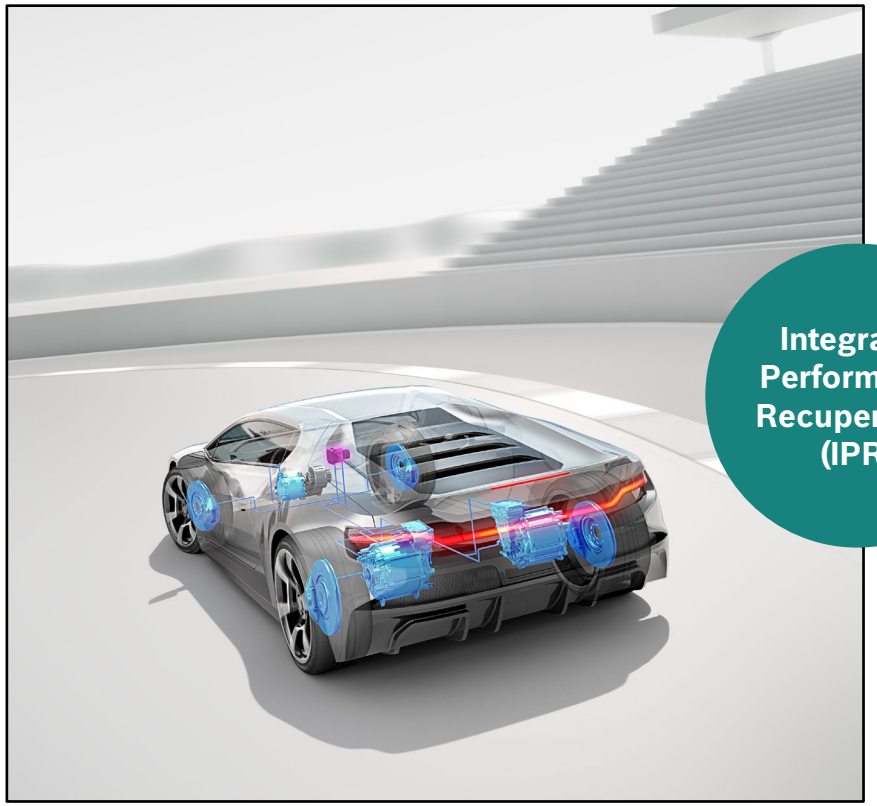
- ABS control strategy with focus also on **lateral dynamics**
- **Brake Slip Vectoring** to improve corner brake behavior
- **Tire** and tire temperature **adapting** control algorithm

General Benefits

- Best in Class **stopping distance**
- **Improved lap times** on racetracks
- Peak Performance regarding **steerability** and **smoothness of control**
- **Consistent braking** performance

Innovations in Vehicle Dynamics Control

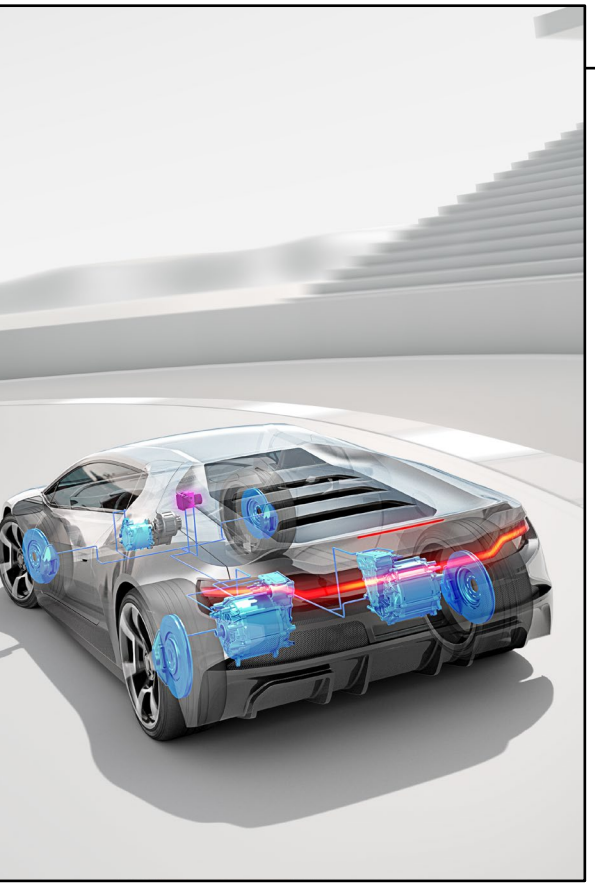
Overview: Integrated Performance Recuperation (IPR)



Integrated Performance Recuperation (IPR)

- Maximization of Regenerative Braking
- Optimized for Racetrack
- Model-based Approach
- 6D-IMU State Estimation
- Distributed Slip Control
- eABS

Innovations in Vehicle Dynamics Control
Integrated Performance Recuperation (IPR)



General Features

- **Integrated approach** instead of friendly coexistence
- **Multi-actuator** wheel slip control, for improved tire slip behavior
- **Scalable solution** for different drivetrains and brake systems
- **FuSa** and **OBD compliant** concept

General Benefits

- **Increased recuperation** in ABS control and on racetracks
- **Improved stopping distance**
- **Improved lap time** on racetracks
- **Natural** and **reliable pedal feel** and **braking behavior**
- **Reduced** friction **brake dust**

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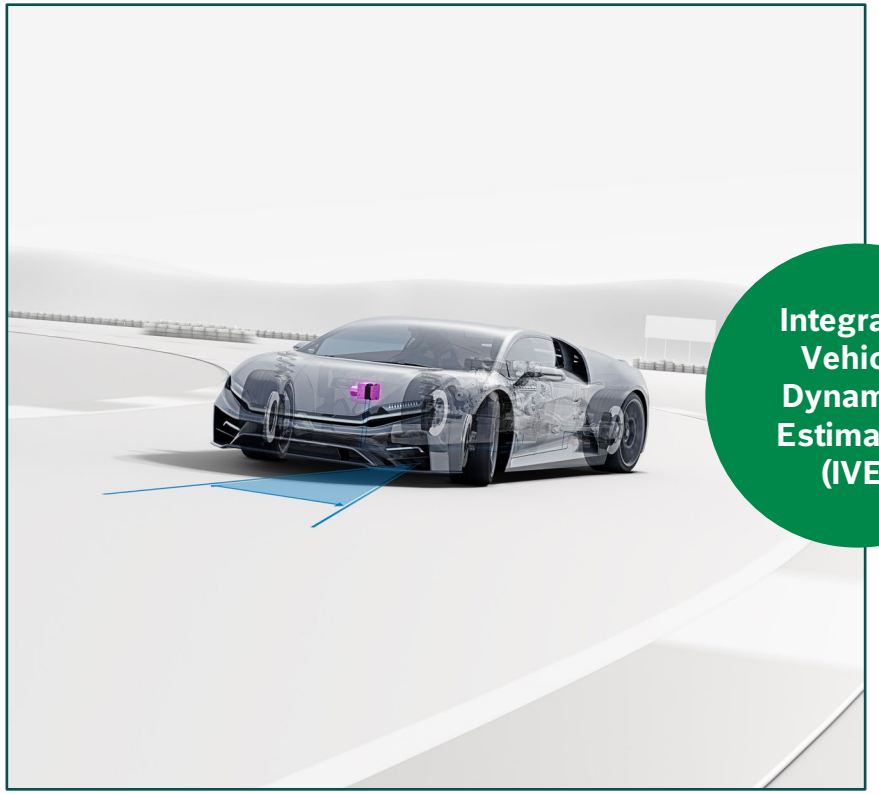
Overview: Integrated Vehicle Dynamics Estimation (IVE)



Integrated Vehicle Dynamics Estimation (IVE)

- Vehicle Speed
- Sideslip Angle
- Road Inclination and Banking
- Maximum Wheel Grip
- Wheel Stiffness
- Actual Wheel Forces

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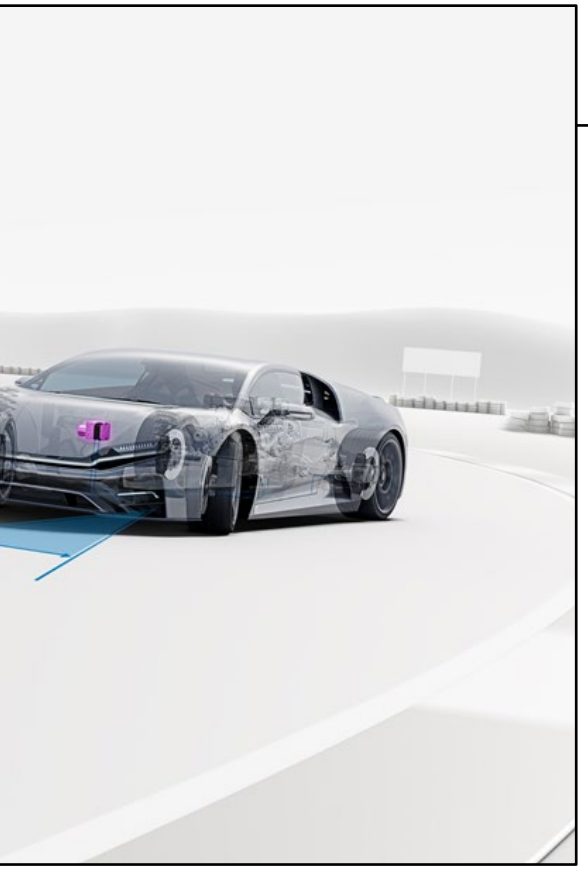
Integrated Vehicle Dynamics Estimation (IVE)



General Features

One **integrated** estimation of **vehicle motion** and **tire parameters**

Model-based design and Kalman filtering considering **highly nonlinear** estimation problem

Take advantage of increased vehicle motion information from a **6D-IMU**

General Benefits

Improved controller behavior due to better quality of estimated signals

Scalable solution regarding focus of estimates

Export of estimates for other controllers

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Overview: Integrated Vehicle Dynamics HMI (IVH)

Integrated Vehicle Dynamics HMI (IVH)

- Predefined Modes
- Independent Change of Vehicle Characteristics
- Continuous Change of Vehicle Characteristics
- Change via Slider
- Change via Dial-Switches
- Track Individual Settings

Innovations in Vehicle Dynamics Control
Integrated Vehicle Dynamics HMI (IVH)

General Features

Vehicle behavior becomes **adjustable by the driver** according to personal preferences and current driving situation

Continuous and **Independent** change of vehicle characteristics due to model- based approach of controllers

General Benefits

Resolving of major tuning compromise in cassis setup: *"There is no ideal setup for a certain car or a certain track. There is only an ideal setup for a certain car on a certain track and a certain **driver**"*

Unique selling point emerged from a totally new dimension in configurability of vehicle dynamics

Integration possibility in **OEM** control and instrumentation **panel-concept**

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Our Services

Support

throughout the whole development process: from **concept phase** to **series production**

Expertise

in controlling any type of **lateral or longitudinal** dynamics relevant actuator

Application

of state-of-the-art, non-linear, model-based (pre)controller design algorithms

Integrated functional approach

for accessing **various actuators** out of one „master chassis controller“

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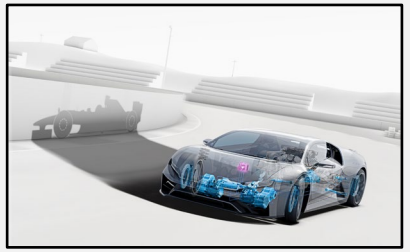
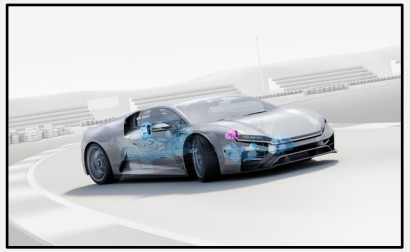
Your Benefits

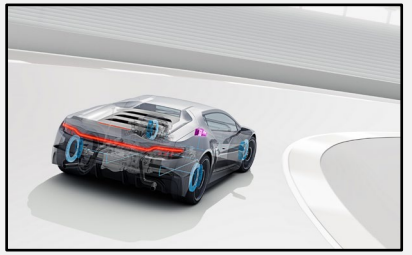


Integrated approach instead of friendly coexistence to **optimize performance** and to **reduce** your **effort** for clarification between several actuator suppliers



Emphasizing and fine tuning of your **brand specific lateral dynamics philosophy**

Scalable solutions for a **central multi actuator control** on a Bosch ESP unit or on a vehicle computer



Natural and **reliable** driving behavior through **model-based** control algorithms

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Contact Persons

Dominik Merlein

Product Manager

Vehicle Dynamics Management

dominik.merlein@de.bosch.com

+49 151 16805247

Dr. Lars Koenig

Chief Expert

Vehicle Dynamics Management

lars.koenig@de.bosch.com

+49 151 54309960

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