

Determination of tyre parameters based on Tyre forces, tyre drift- and camber angle

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Tyre Development

- Safety
- Comfort
- Driving dynamics



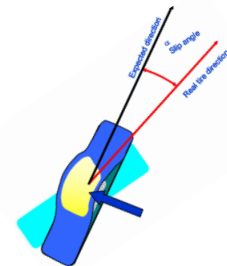
Why is it so important?

- Tyre is the link between car and road
- Transfer all acting forces of a chassis to the surface
- Tyre defines part of characteristic of a chassis and so a direct influence to the car

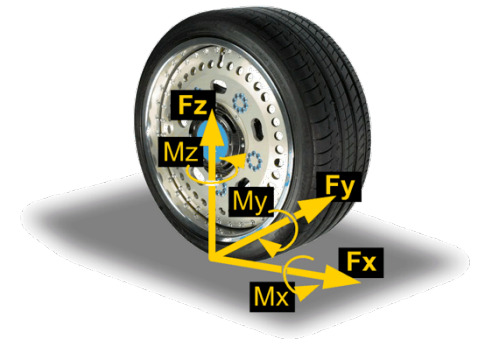
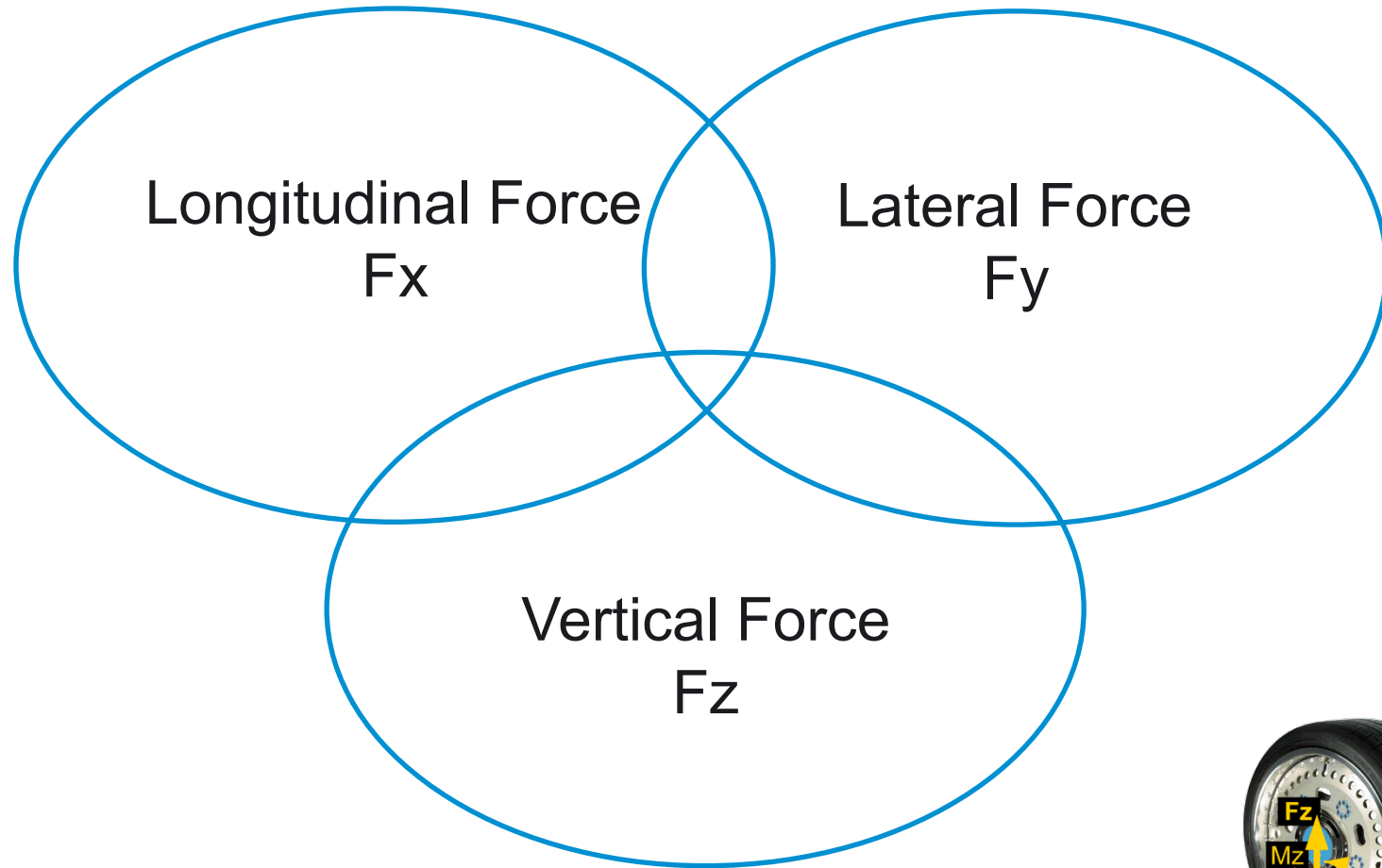
Influences to a tyre

The ability of a tyre to transfer forces is influenced by:

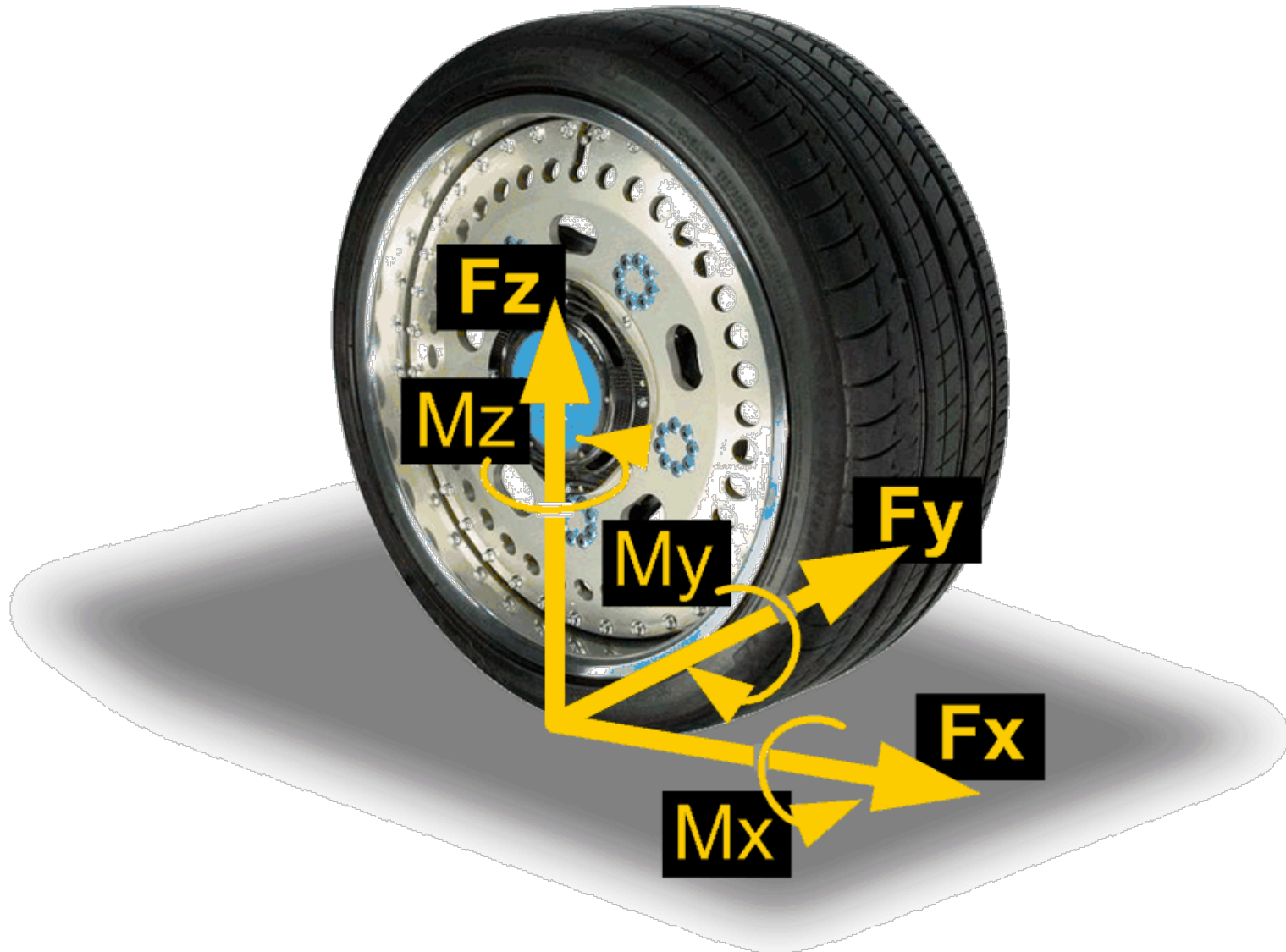
- Tyre construction
- Compound
- Surface / Surface condition
- Pressure / Temperature
- Tyre slip
- Tyre drift angle
- Camber angle
- ...



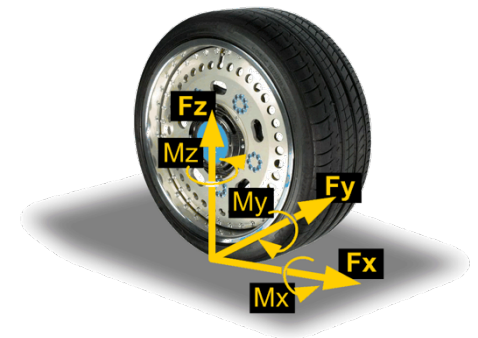
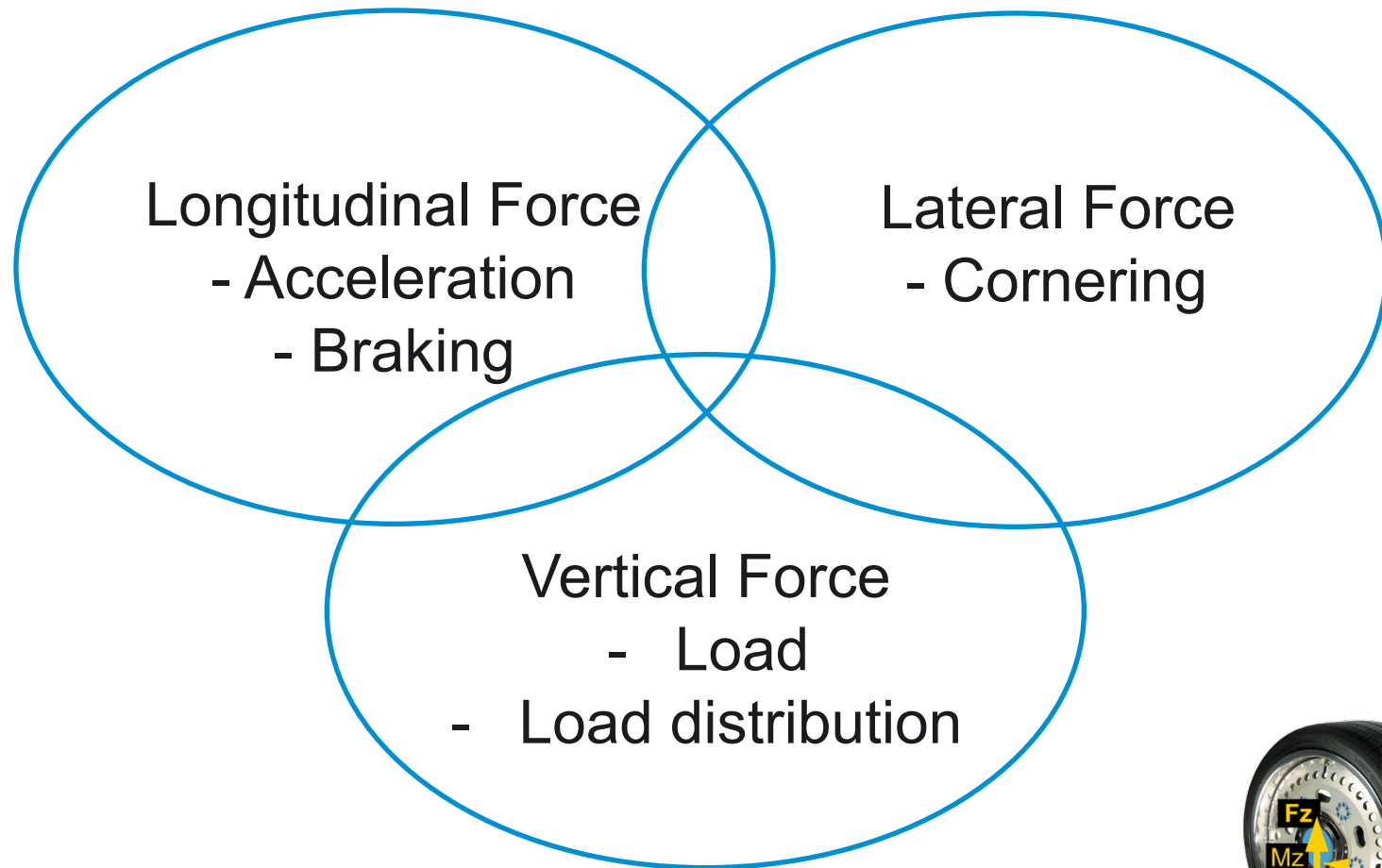
Overview



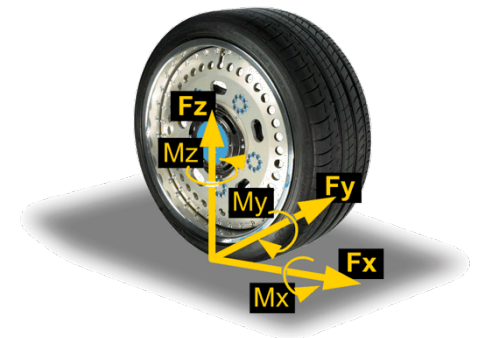
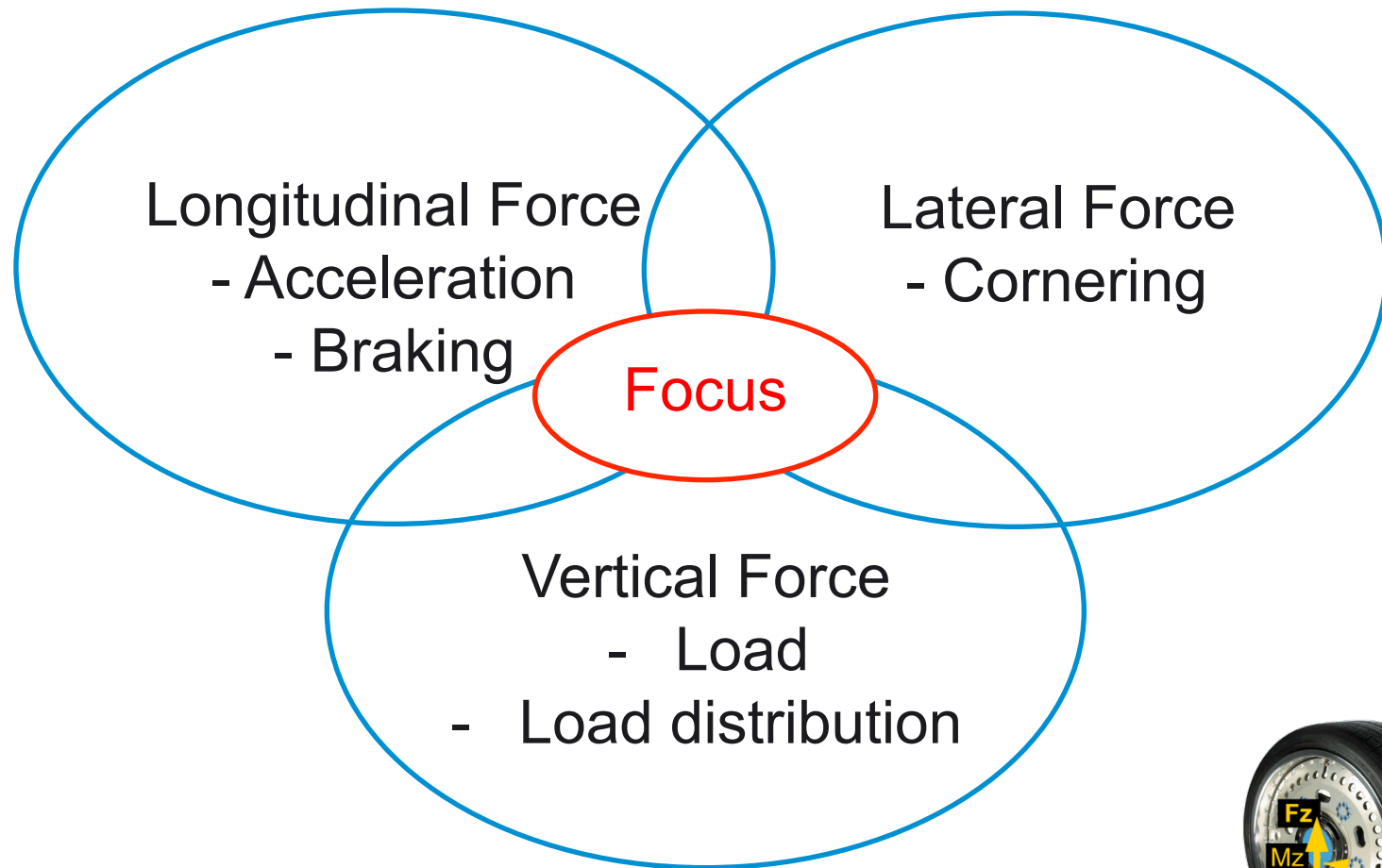
Overview



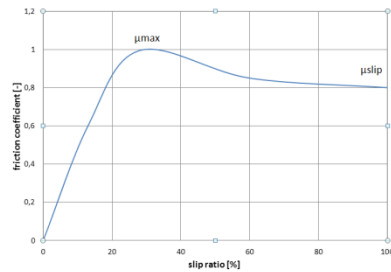
Overview



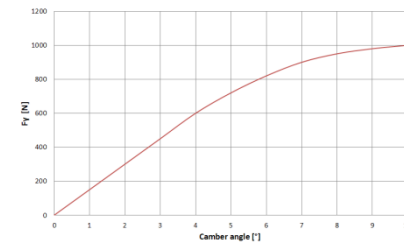
Overview



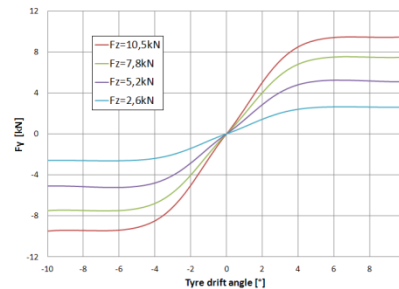
Tyre slip



Tyre drift angle



Camber angle



Tyre slip

- Depends mainly on Tyre (Type / Structure), surface and surface condition
- Example: Aquaplaning
- Tyre is loosing contact to surface
- Tyre can not transfer force to surface
- Wheel speed to car speed changes
- Slip at acceleration and braking

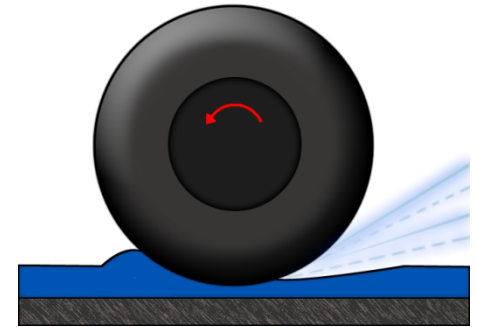
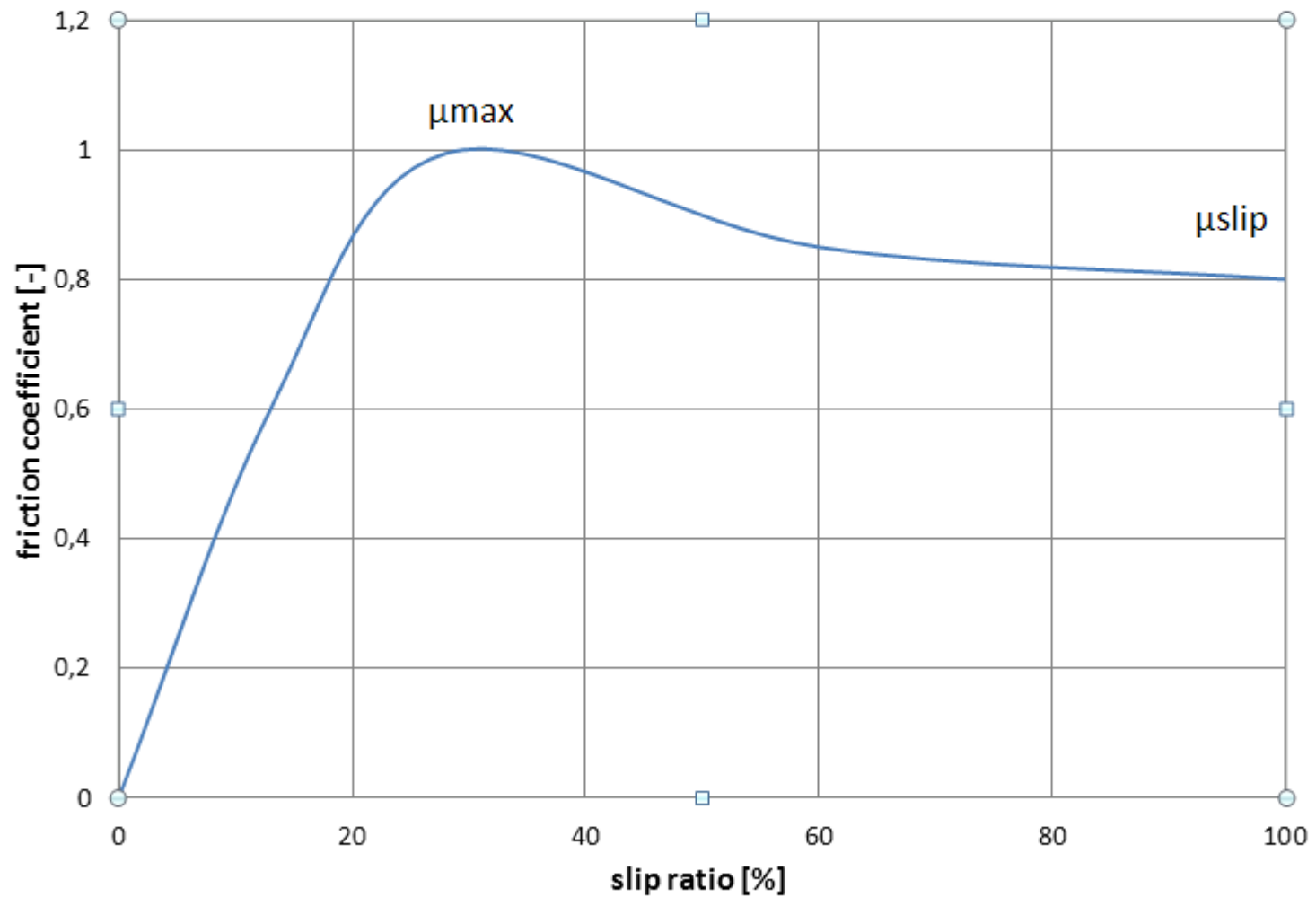
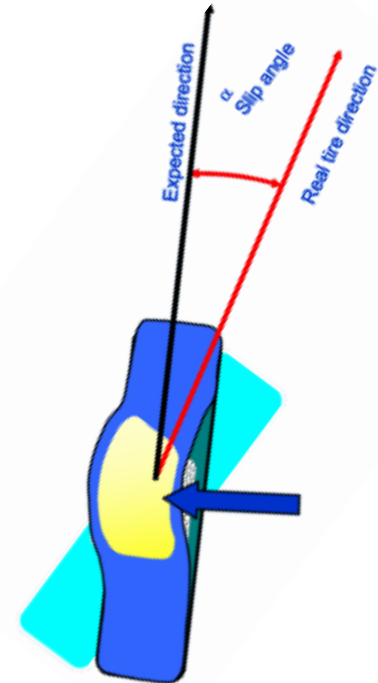


Diagram tyre slip

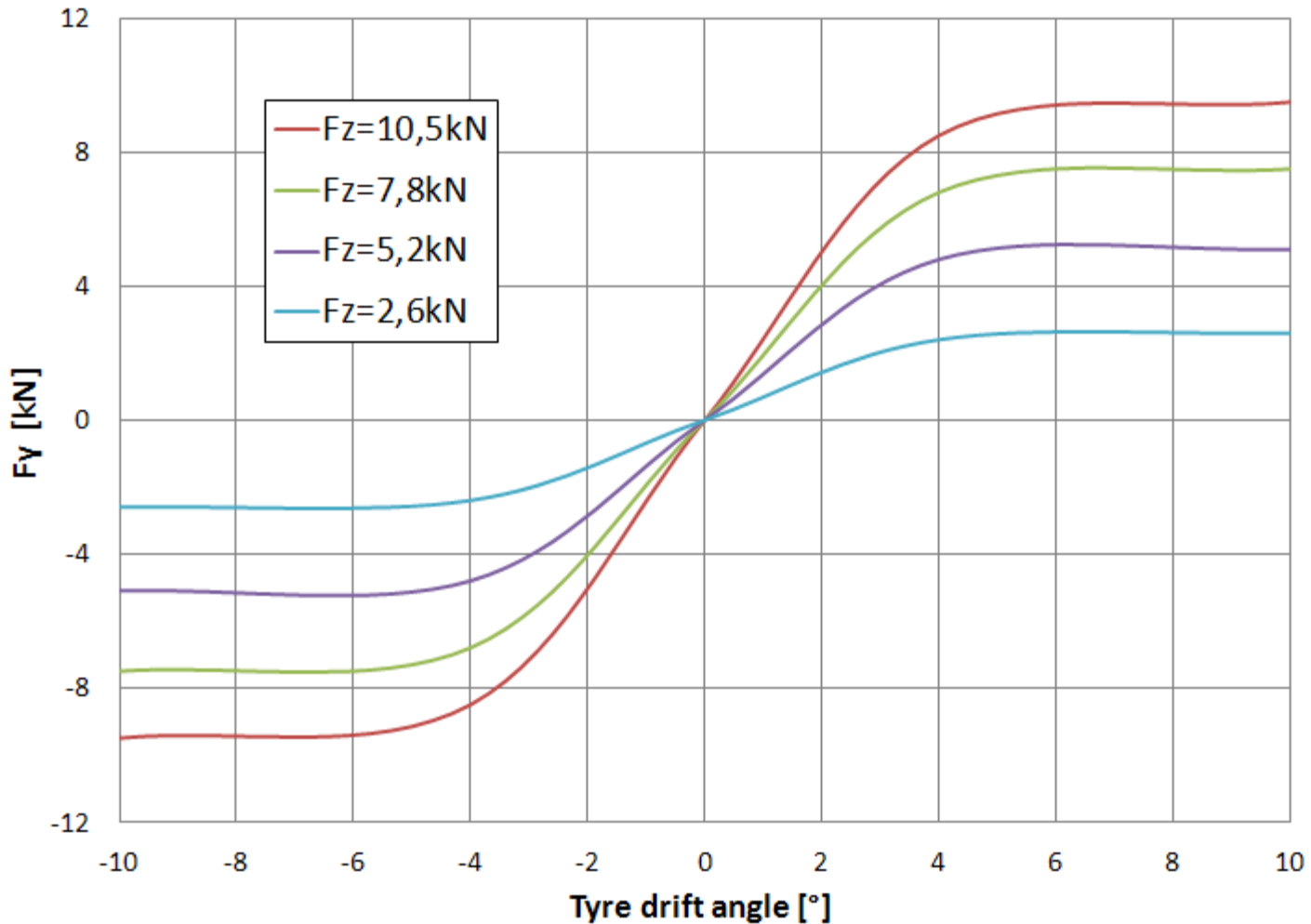


Tyre drift angle

- Lateral force will applied (e.g. cornering)
- By applying force and due to the elasticity of tyre, the tyre itself and latch gets deformed
- Lateral slip occurs
- Resulting driving direction is different to driving direction without transversal force
- Slip angle is difference between this two driving directions

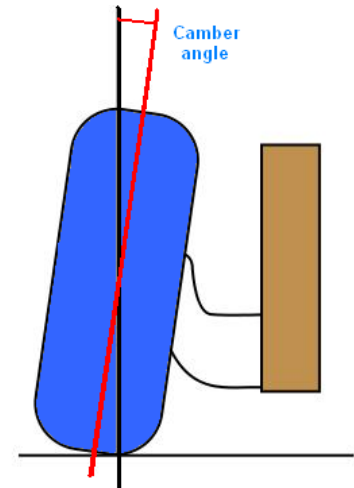


Lateral force vs. Tyre drift angle

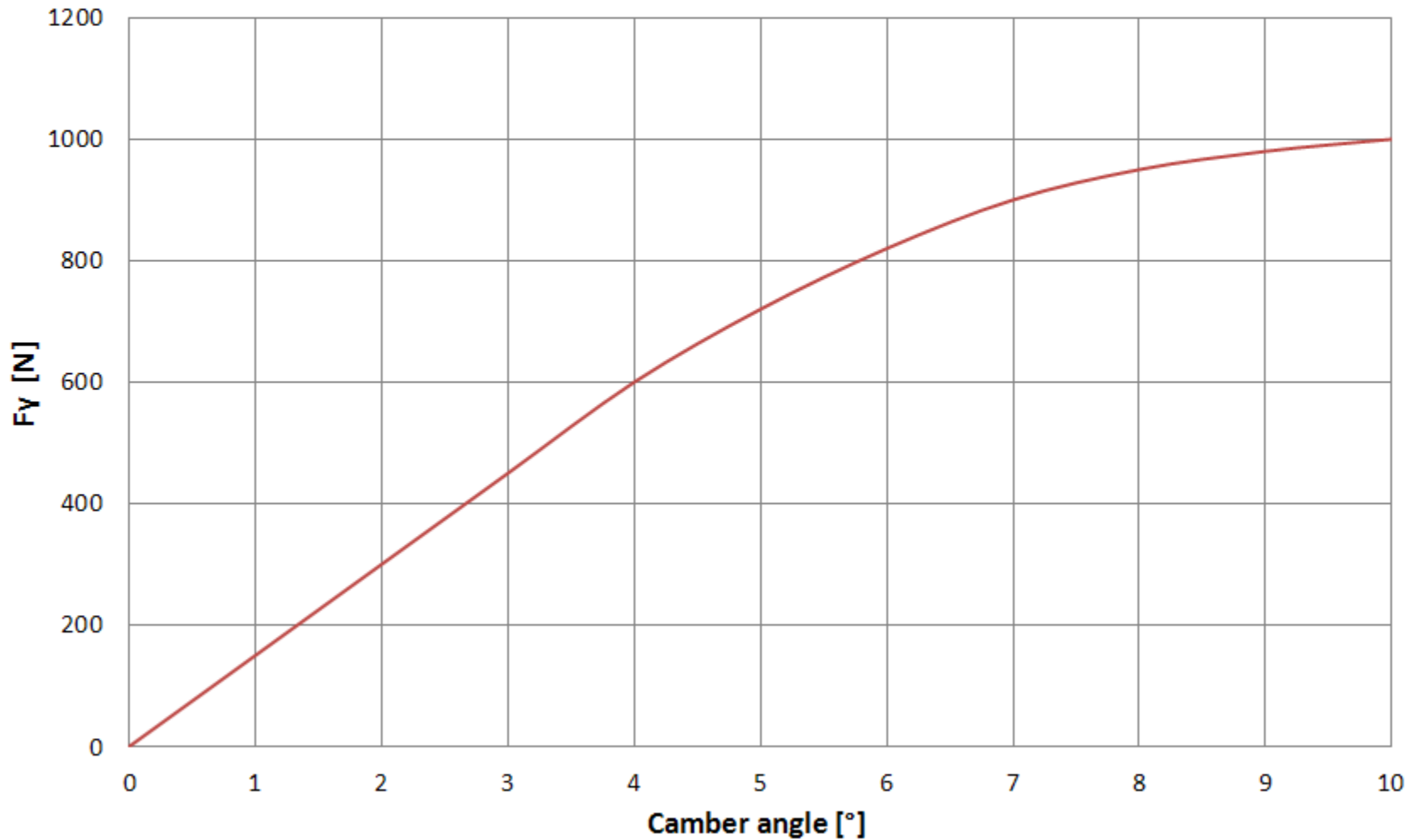


Camber angle

- Camber angle is defined as **Z-axis of tyre** to „vertical axis“ of surface
- With higher camber angle, contact patch becomes smaller
- Less transversal force can be applied
- Camber angle is influenced by:
 - - wheel suspension
 - - load, dynamic load distribution,...
- Parameter for suspension setup

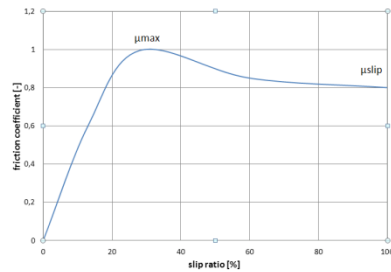


Lateral force vs. camber angle

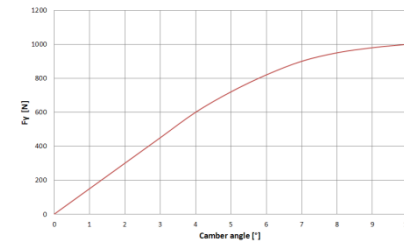


Influences

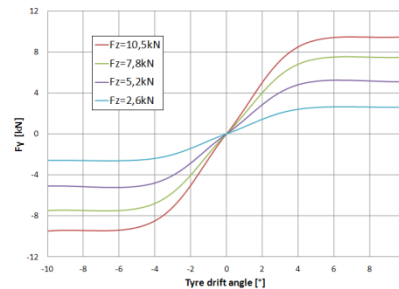
Tyre slip



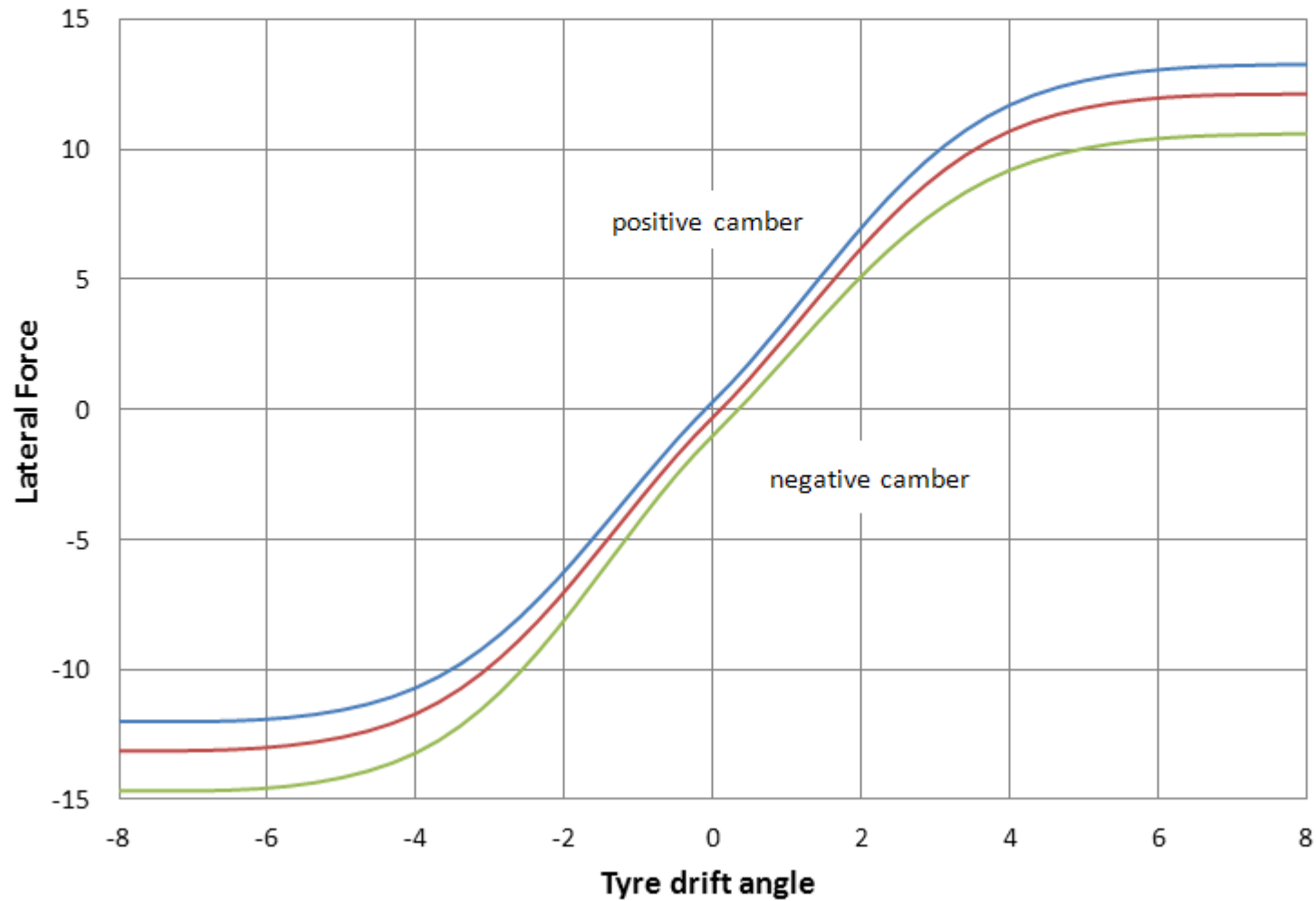
Tyre drift angle



Camber angle



Lateral force vs. camber angle and tyre drift angle



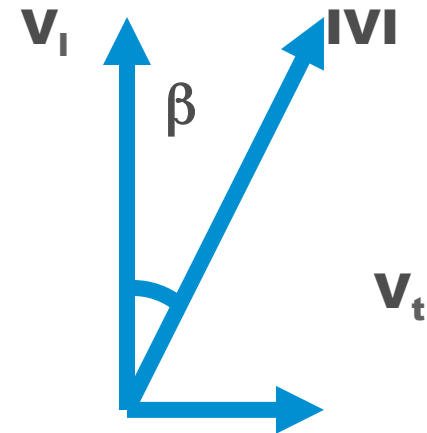
Wheel force transducer

- Measurement hub
- Standard Rim will be replaced
- Wheel force F_x , F_y , F_z
- Moment M_x , M_y , M_z
- Rotational speed / angle



Speed and slip angle sensor

- Optical sensor
- Noncontact
- Longitudinal speed
- Transversal speed
- Absolute speed
- Body slip-, tyre dft angle



Dynamic camber system DCA

- Optical, noncontact sensor system
- Basis: 2 Laser height sensors
- Mounting rig
- Absolute height measurement
- Dynamic camber is calculated by height differences and mounting distance



Sensor System

- Wheel force transducer



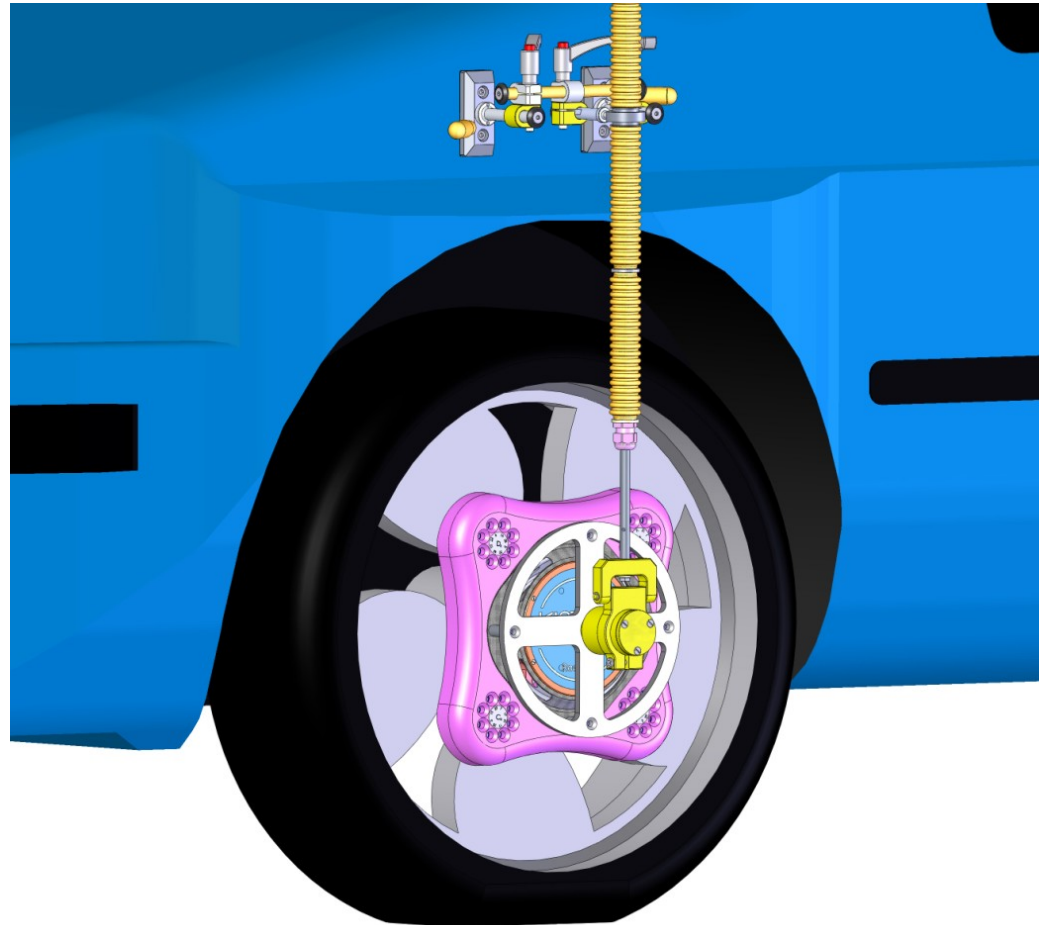
Sensor System

- Wheel force transducer
- Adapter



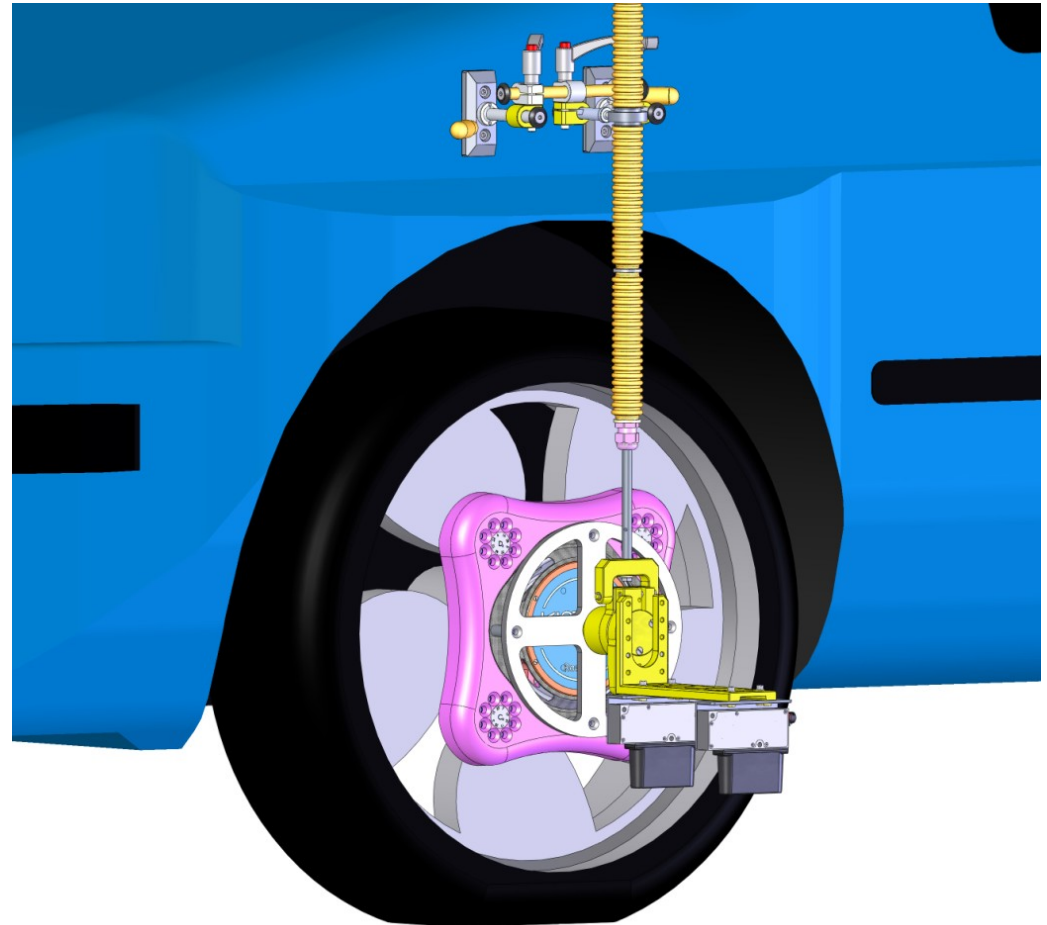
Sensor System

- Wheel force transducer
- Adapter
- Tension rod



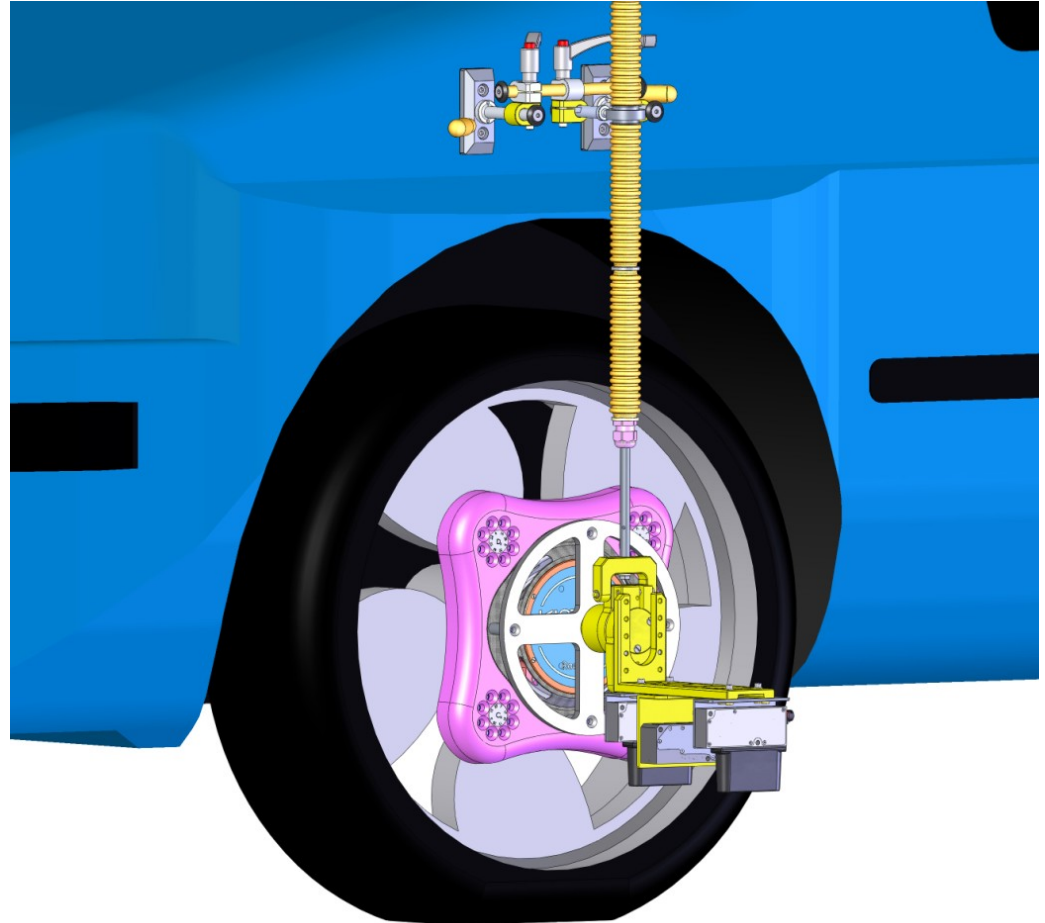
Sensor System

- Wheel force transducer
- Adapter
- Tension rod
- DCA System



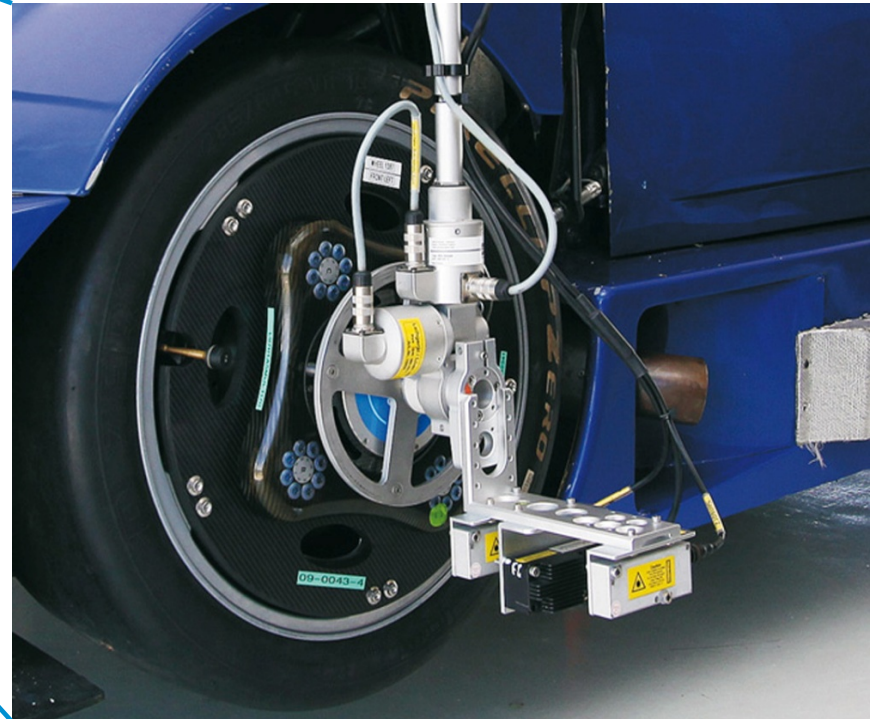
Sensor System

- Wheel force transducer
- Adapter
- Tension rod
- DCA System
- Speed and slip angle Sensor



Sensor System

KISTLER
measure. analyze. innovate.



Sensor System

Sources:

- Wheel force Transducer:
 - Forces: F_x , F_y , F_z ,
 - Moments: M_x , M_y , M_z ,
 - Rotational angle / speed
- DCA:
 - Height, camber angle
- Slip angle sensor:
 - Speed: V_{abs} , V_x , V_y
 - Slip angle

