Vehicle Dynamics Measurement

A&D Testing Services

Discover Precision

Synchronized vehicle dynamics data under real-world conditions

Using A&D's Vehicle Measurement System (VMS), A&D provides synchronized vehicle behavior data gathered under designated driving conditions. The VMS is a high-accuracy system consisting of three sensor modules that collect data simultaneously:

Wheel Force Sensor (WFS)

Measures all forces and moments on the wheel (Fx, Fy, Fz, Mx, My, Mz), as well as angular velocity of the wheel
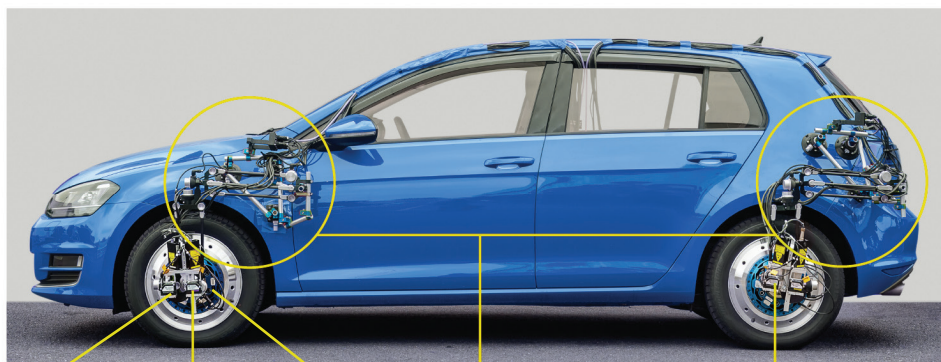
Wheel Position Sensor (WPS)

Collects data on the motion of the wheel relative to the chassis in five degrees of freedom

Laser Ground Sensor (LGS)

Provides dynamic side-slip and camber angles; also measures longitudinal and lateral wheel speeds and the effective tire radius

By attaching external sensors, such as an Inertial Measurement Unit (IMU) or steering angle sensor, other characteristics, such as the change in the center of gravity or steering ratio of the vehicle can be identified.

Using this integrated vehicle behavior data, it is possible to calculate the road gradient or snow-covered road surface μ. Other useful applications include developing Pacejka tire models and identifying suspension parameters.

LGS   WFS   WFS   WPS   WFS
        LGS   LGS

The Vehicle Measurement (VMS) consists of a Wheel Force Sensor (WFS), Wheel Position Sensor (WPS) and a Laser Ground Sensor (LGS).

Included:

- Testing using either standard or customer-requested test procedures

- Creation of customer-requested test procedures

- Data collection for tire characteristics analysis or tire model creation

Measurements:

- WFS - Forces (Fx,Fy,Fz) Moments (Mx,My,Mz,), angular position and velocity of wheel

- WPS - Px,Py,Pz camber angle and tow angle in relation to the vehicle body

- LGS
  - Wheel speed (Vx,Vy),
  - Slip angle (θs),
  - Wheel camber angle (θc) with respect to the ground
  - Wheel pitch angle (θp) used for data correction
  - Effective tire radius (distance from the center of the tire to the ground).

- Time series data of the above

Example

ISO-compliant measurement test services

Provide ISO-compliant stationary and transient test data by measuring vehicle behavior

• Stationary circle turning test (ISO4138)
• Steering transient response test (ISO7401, Sine wave steering/step steering test)
• Steering closed loop test (ISO3888-1, double lane-change test)

Data can be used with simulation software, such as CarSim® and CarMaker®, for vehicle behavior analysis.

Transient response example of wheel forces and vehicle behavior against steering input
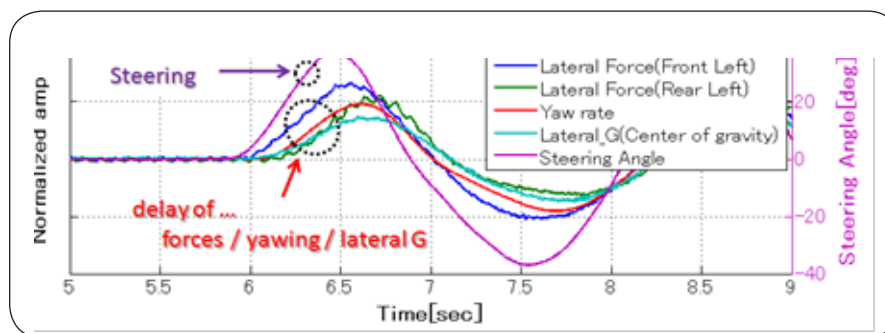
Vertical axis: Normalized amplitude (wheel force/vehicle yaw rate/vehicle side G)
Horizontal axis: Time

Pacejka Tire Modeling
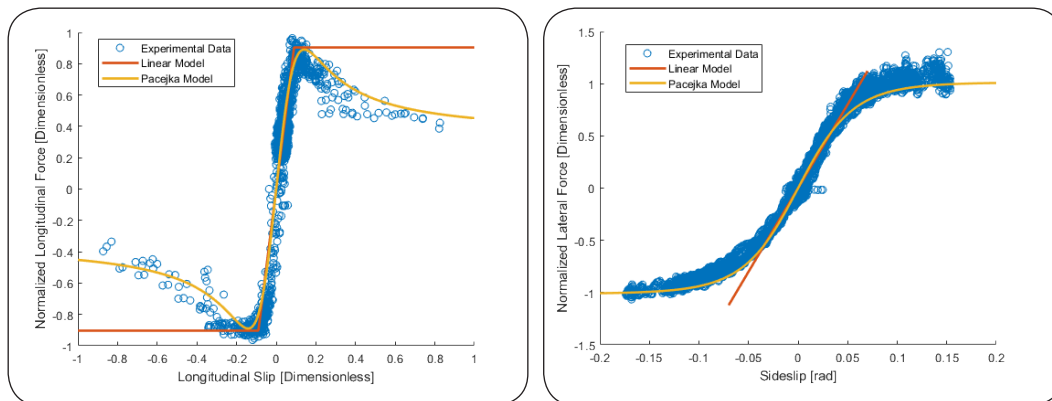
Vertical axis: Normalized Longitudinal Force (Fx/Fz)/Normalized Lateral Force (Fy/Fz)
Horizontal axis: Longitudinal Slip/Side-slip Angle