



- X-in-the-loop test and simulation techniques
- Assistance systems for optimized driving safety and energy efficiency
- longitudinal and transverse dynamics control for autonomous vehicles
- Integrated active suspension systems for multi-actuated and electric drive vehicles
- Research and test center for non-exhaust-emissions



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Automotive Engineering

1. Testing Facilities (System)



MASTER: Four-Roller Power Dynamometer

Modern vehicles are equipped with an increasing number of technical functions in order to enhance safety, comfort and performance. Despite the increasing complexity, manufacturers expect short development cycles with a constant price-performance ratio. Therefore the four-wheel power dynamometer was integrated as a MASTER node in a real-time test and development environment, which allows to test products from different development stages. This leads a faster and more effective development of automobiles.



Automotive Engineering

1. Testing Facilities (System)



MASTER: Four-Roller Power Dynamometer

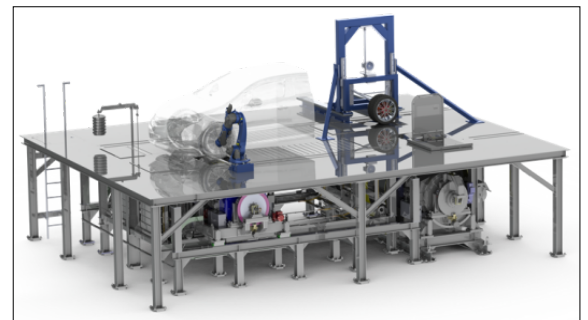
Technical Properties

- Test chamber (LxBxH) 12x7, 5x4,5 m
- Air conditioning -20 bis 45 °C
- Max. power 4x230 kW
- Roller diameter front 48", rear 75"
- Wheel and axle load operation possible



Corner Module

- Examination of longitudinal-, transverse- and vertical-dynamic tire characteristics
- Analysis of electric drives up to 250 kW
- Experimental analysis of spring, damper and suspension characteristics



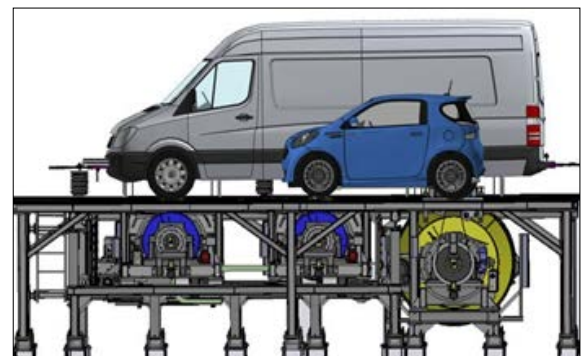
Environmental Analysis of Emissions

- Environmental analysis of exhaust and non exhaust particle emissions
- Automated measuring head positioning using an industrial robot
- Efficiency optimization / friction reduction on the subsystem level for reduced CO² emissions



Vehicle Properties

- Speed up to 250 km / h
- Spreading width 0.8 to 2.3 m
- Wheelbase 2.1 to 4.4 m
- Max. Wheel load 1.25 t



Automotive Engineering

1. Testing Facilities (System)



Testing Center for Suspension and Brake Systems

Testing center used for interdisciplinary research tasks with regard to driving safety, driving comfort and environmental protection.

- Simulation of heavy vehicles (transporters)
- High performance testing and comfort analysis (NVH)
- Investigations on braking systems, chassis components and complete axles

Specifications:

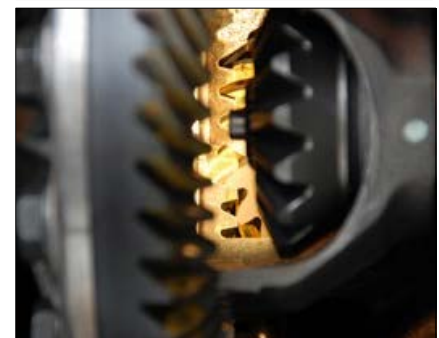
- Revs: $n_{max} = 2500 \text{ min}^{-1}$
- Speed: $v_{max} = 310 \text{ km/h}$
- Momentum: $M_{max} = 2300 \text{ Nm}$ (bis ca. 1100 min^{-1})
- Inertia: $I_{max} = 191 \text{ kgm}^2$
- Air conditioning: $Q_{max} = 4200 \text{ m}^3/\text{h}$
-20 bis +50 °C; 15-85% rel. Feuchte



Drive Train Test Centre

The drive train test centre allows interdisciplinary research tasks on vehicle components of conventional and alternative drive concepts with regard to efficiency, environmental compatibility and comfort properties.

- 3-machine operation: Axle drives,
Drive train: Crankshaft, side shaft
Transmission
- 2-maschine-operation: Manual and automatic transmission
- 1-Maschinen-Betrieb: Internal combustion engines
Electric engines
Brake components



Automotive Engineering

1. Testing Facilities (System)



Experimental Platform for Real-Time Coupling

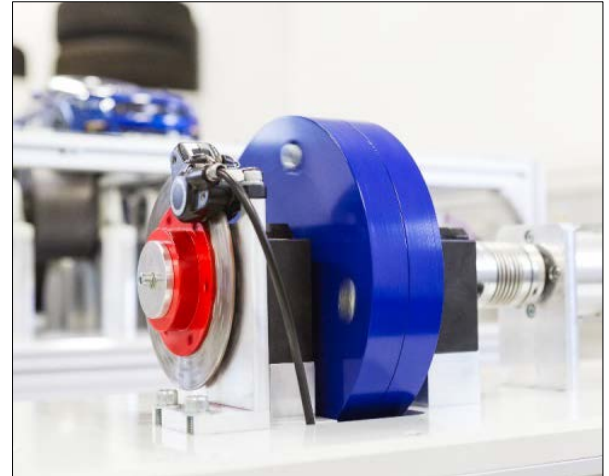
Model Roller Dynamometer

- Demonstrator for real-time coupling of roller test stands and simulation platforms
- Scaled illustration of test scenarios for drive and suspension technology
- Real-time coupling enables a reproducible, true-to-life test
- Investigation of complex physical phenomena



Model Brake Dynamometer

- Demonstrator for real-time coupling of brake test stands and simulation platforms
- Scaled illustration of test scenarios for brake technology
- Real-time coupling enables a reproducible, true-to-life test
- Consideration of complex tribological properties



Automotive Engineering

1. Testing Facilities (Components)



Friction Test Stand / Flywheel Brake Dynamometer

The inertia test bench is used as an experimental environment for the determination of friction coefficients as well as a brake performance test stand for standardized brake tests.

- AK master tests
- SBWT Test (Short Bosh Wear test)
- Noise analysis (NVH)
- Denver test
- Cracking test
- NEXT test

Specifications:

- Speed: $n_{max} = 2000 \text{ min}^{-1}$
- Speed: $v_{max} = 250 \text{ km / h}$
- Drive: $M_{max} = 2000 \text{ Nm}$
- Moment of inertia: $I_{max} = 106.7 \text{ kgm}^2$



Friction Test System for Shock Absorbers

Galdabini Quasar 5

Machine for tensile and compression tests for the material characterization of elastomers, which has been specially developed for friction measurements in automotive shock absorbers.

Specifications:

- Standard measuring equipment: force sensor + extensometer
- Additional force, pressure and differential pressure sensors Additional attachments for introducing lateral forces into the damper



Source: Galdabini

Automotive Engineering

1. Testing Facilities (Components)

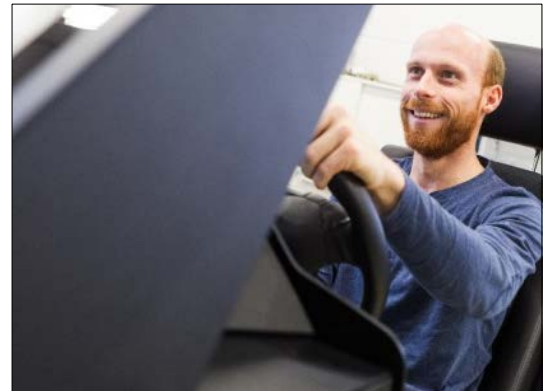


Driving Simulator

Simulator-Platform

Platform for Investigations on user acceptance of various assistance systems and human-machineinteraction (MTI or HMI).

- Realization of driving dynamics with any software tools (IPG CarMaker / PreScan)
- CAN communication allows the steering wheel to be influenced in the form of stiffness, damping and friction
- Communication hardware (dSpace / National Instruments): Real-time transmission of torque and angle to the simulation environment - back-coupled active adjustment of the steering wheel



Hexapod

- Extension by a hexapod to a dynamic driving simulator from 2018 onwards
- Opening up new areas of investigation: Higher speeds, floating angles and a better haptic feeling for the dynamic processes in the virtual vehicle



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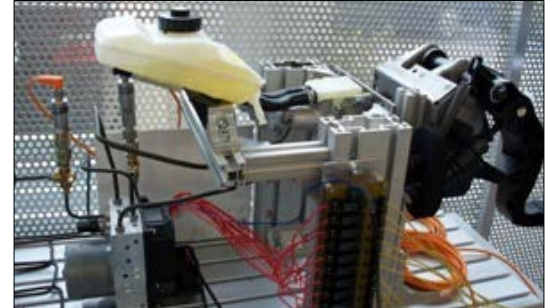
1. Testing Facilities (Components)



Hardware-in-the-Loop Test Stand

Test stand for the investigation of algorithms developed for anti blocking systems (ABS), electronic stability programs (ESP) and other driving safety systems.

- Hardware: Main brake cylinder, four Wheel brakes, hydraulic control
- Hydraulic control unit (HCU) follows control strategies implemented in MATLAB / Simulink using a dSpace interface



Servo-hydraulic Test Stand (Hydropulser)

Static and dynamic testing of assemblies and parts

Specifications:

- Compressive force: $F_{max} = \pm 25 \text{ kN}$
- Amplitude: $s_{max} = \pm 125 \text{ mm}$
- Frequency: $f_{max} = 100 \text{ Hz}$
- Acceleration: $a_{max} = 300 \text{ m / s}^2$
- Operating modes: force-controlled or length-controlled



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1. Testing Facilities (Components)



Steering Test Stand

The test rig allows static and dynamic simulation of stress scenarios for steering assistance and actuation systems as well as power and efficiency measurements.

Specifications:

- Force and travel control (maximum force 18 kN, maximum travel distance 200 mm, maximum speed 385 mm / s)
- Analysis of the overall system and components
- Implementation of the test object as passive or active system
- On-board network simulation by programmable power supply
- Potential implementation of a steering column



Brake Lining Compression and Shear Test Stand

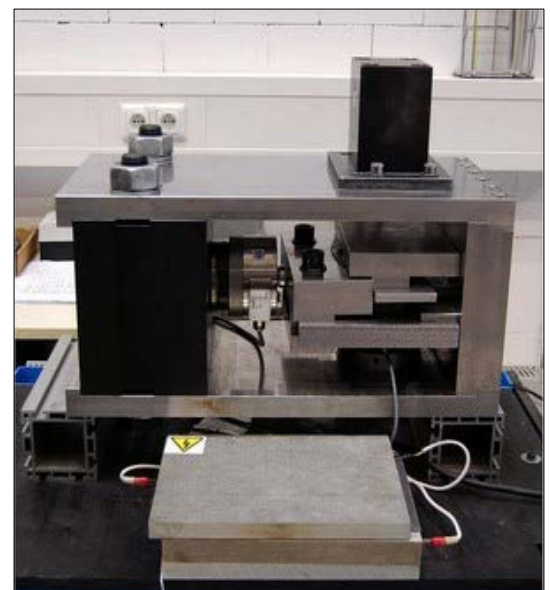
Combined testing device for compressive and shearing tests on friction linings

Compression Test ISO 6310

- Performing cold and hot tests (400 °C)
- Pressure or force controlled
- Load speed: 4 kN/s or 80 bar/s
- Preload: 5 bar
- Maximum load: 160 bar

Shear Test ISO 6312

- Cold as well as hot tests (300 °C)
- Force or travel controlled
- Load speed: 4.5 kN/s or 10 mm/min
- Preload: 5 bar
- Maximum force: 200 kN



Automotive Engineering

1. Testing Facilities (Components)



Wind Tunnel

Modular wind tunnel (Göttingen design), which is used in conjunction with a PIV system to verify of flow simulations (FLUENT). Therefore a particle generator is available for particle injection into the flow.

- Wind tunnel: Length: 3m x Height: 1m x Channel width: 200mm
- Measurement Cell: L: 700mm x H: 100mm x W: 100mm



Tire Test Stand

- Development of tire testing equipment
- Visualization of tire vibrations
- Recording of any kind of tires
- One or two roller supporting the tire
- Adjustable static radial load
- PC-controlled speed control
- Visualization of tire contact surface



Vibration Testing System

TIRA TV 50350-120

Examination of component vibrations and durability

Specifications:

- Rated Power: Sine: 2700 N; Shock: 4000 N
- Swing path max. 25.4 mm
- Sample weight up to 25 kg



Automotive Engineering

1. Testing Facilities (Components)



Hot Gas Test Rig

Test stand for life and function testing of novel thermo-sensors

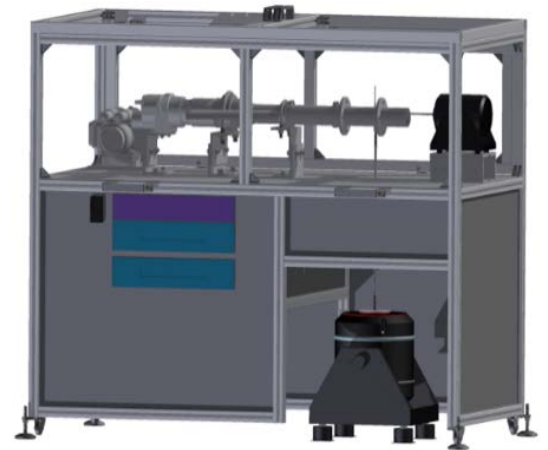
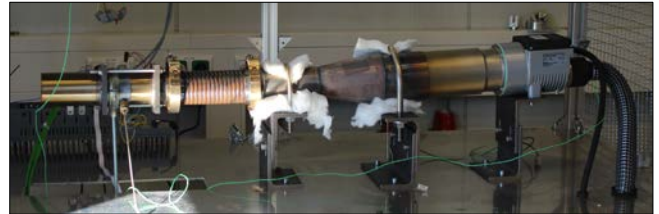
- L x W x H: 1800 x 1000 x 1600

Air heaters

- Rated power 15 kW
- Maximum temperature approx. 900 °C
- Air flow approx. 1000 l / min

Vibration Test Systems TV52165 / TV51110

- Radial and axial loading of the thermo-sensors
- Frequency range 2-7000 Hz



Climate Test Chamber

FEUTRON 3636/17

Climatic examination of components

Specifications:

- Chamber volume 600l
- (770x1020x745) mm
- Sample weight 3x30 kg
- Temperature range (-75 ... 180) °C
- Humidity range (10 ... 95)%
- Change speed $\pm 5K$





Particle Image Velocimetry (PIV)

2D/3D – Flow visualization for various vehicle technical applications

Laser: Double pulsed laser Nd:YAG200
mJ/Puls at 532 nm, 15 Hz

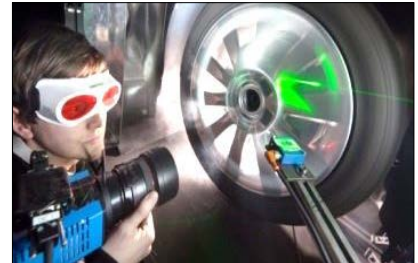
Camera: 2x 2048x2048 Pixel, 4 GB, 14 Bit,
15.56 fps, 400 ns Interframing-time

Optic: Movable mirror arm, divergent laser
optic,
35/50/85mm AF objectives

Equipment: Particle Generator, 1 μm
2x Tilt Adapter
X-Z traverse

Computer: Synchronisation unit, Workstation

Software: VidPIV + Tecplot 360



3D Laser Scanning Vibrometer

PSV 400 3D

Non-contact 3D vibration measurement technology,
Applicable also at the customer site

Specifications:

Frequency range: 0 – 1 MHz

Data collection: 4 canals

Distance: > 0,4 m

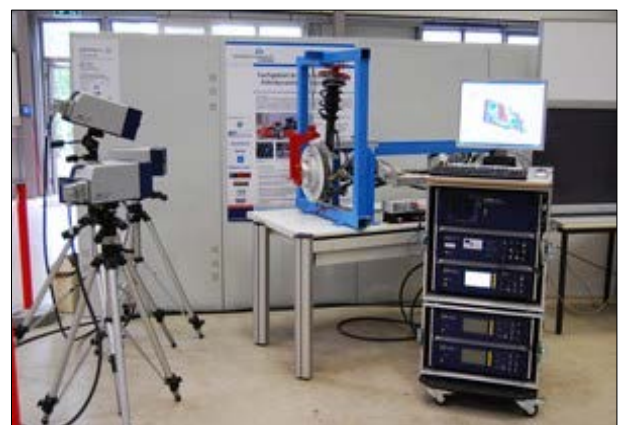
Object width: $\geq 1 \text{ mm}^2$

Velocity: 10 m/s (max.), 2,5 MHz (max.)
0,5 m/s (max.), 350 kHz (max.)

Signal generator 512 kHz (bandwidth)
0 – 10V, $\pm 5 \text{ mA}$

Measurement: 2x2 up to 512x512
measurement points

Resolution: 6400 FFT lines

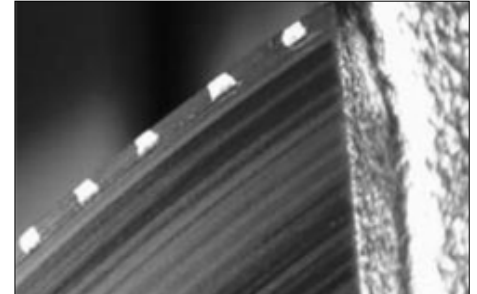




High Speed Camera

Photron Fastcam Ultima APX RS, model 250K

- Recording up to 1024 x 1024 px
- At maximum resolution frame rates up to 3000 pictures/s
- Maximum image rates at low resolution of up to 250,000 frames/s
- Sensitivity of the sensor: 6400 ISO / ASA with a digitization of 10 bits and 17 μm pixel size
- Exposure times up to 1 μs allow the recording of very bright objects



Source: Photron

Real-Time Systems for Measurement and Control Tasks

PXI/Compact-PCI (Fa. National Instruments)

Autobox (Fa. dSpace):

- Prozessor-Board, DAQ-Board, HIL-Board
- 7 slots (AutoBox)
- Operation with 12V, 24V and 48V vehicle wiring

MicroLabBox (Pr. dSPACE):

- DS1202 Processor-Board
- A/D and D/A I/O Boards
- CAN Communication

Hardware-in-the-Loop Test Stand (Pr. dSPACE):

- DS1006 Processor-Board
- A/D und D/A I/O Boards
- CAN und FlexRay Communication
- Integrated control of Suspension systems



Source: dSpace



Bidirectional Telemetry System

System for bidirectional data transmission between the main station and a test vehicle, which is used for vehicle dynamics development and modeling (analysis of driving behavior).

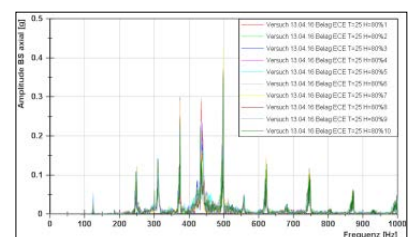
- 3km range (omnidirectional)
- Sampling rate 48kSps (stand-alone mode) 24kSps (modules coupled)
- Bandwidth per channel 20kHz (stand-alone mode) 10kHz (modules coupled)
- 8x Analog, 4x Digital, 8x ICP, 4x Thermocouple, 1x CAN



Vibration and Acoustics Measuring System

LMS SCADAS Mobile

- Mobile test hardware for noise, vibration and lifetime tests
- Compact size and light weight
- Robust design for extreme conditions and temperatures
- Very quiet, operation without fan
- Up to 204.8 kHz sampling rate per channel
- 24-bit ADC technology
- 150 dB dynamic range





Driving Dynamics Measurement

DATRON

- Two-axis correlation-optical sensor
- Non-contact, slip-free travel and speed measurement in 2 axes
- Slant and float angle determination
- Speed measuring range: 0.5 - 310 km / h
- Angle measuring range: ± 40



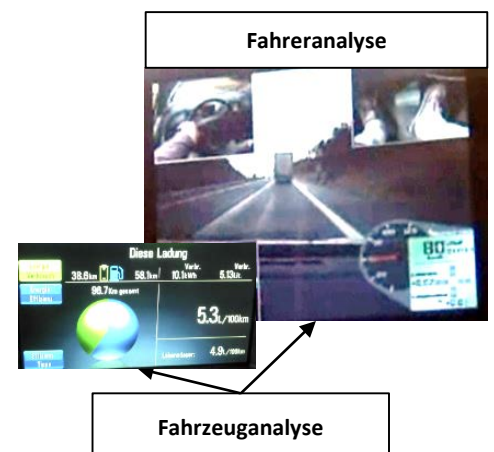
Source: Racelogic

Racelogic VB3i / Video VBOX Pro

- Detection of driving condition sizes, e.g. Speed, lateral and longitudinal acceleration as well as position in combination with a 4-channel camera system for driving documentation
- Additional equipment for highly dynamic vehicle data and vehicle dynamics measurement
- Measurement wheel - Correvit Datron

Specifications:

- 100 Hz DGPS
- 500 K Can-Bus-Anschluss
- Data logger
- 4xAI, 2xAO, 2xDI, 2xDO
- 4 cameras
- 2 Microphone
- Video-Overlay





Fuel Consumption Measurement System

Gregory Flowtronic Sensor Series S8005

Accurate measurement of the fuel consumption of internal combustion engines with high accuracy

- Can be used on engines with petrol, diesel, alcohol and biofuels
- Accurate and highly dynamic measurement of minimum flow rates (idle) and high volume flows (full load)
- Can be used in mobile driving tests as well as on the test bench

Specifications:

- Measuring range: 0.1 to 250 l / h
- Measurement accuracy: +/- 0.5%
- Volume resolution: 0.004 ml



Source: Gregory

Engine Tester

Bosch KTS 650

- Equipped with 1 GB RAM and 40 GB HDD
- Integrated 2-channel multimeter for voltage, current and resistance measurement
- Integrated 2-channel oscilloscope with 2 x 5 MSample/s
- Extensive test software Bosch ESI [tronic] (training version)
- Supports all common OBD protocols





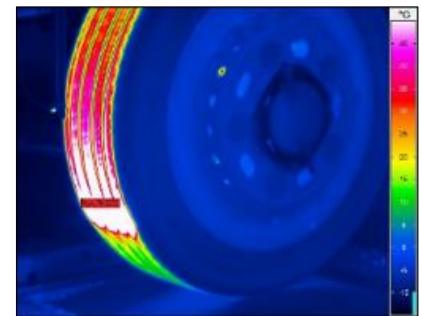
Temperature Measurement

Thermography Camera InfraTec ImageIR 8300

Detector format: (640 x 512) Infrared-Pixel
Temperature resolution: 20 mK
Spectral range: MWIR, (2,0 ... 5,7) μm
Frame rate: Full image: 355 Hz
Half image: 670 Hz
Quarter imager: 1.200 Hz
Split image-line-mode: 5.000 Hz
Measurement accuracy: +/- 1 K or +/- 1 %
Calibration: 10 up to 850 ° C



Source: InfraTec



Free-Sense HAT cRIO-9082

- Intel Core i7, 2GB RAM, 32 GB
- LabView Real-Time
- Maximum number of measuring cards: 8

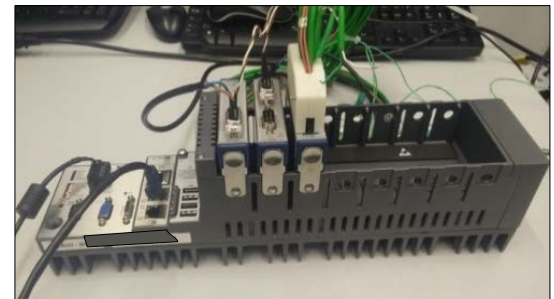
Temperature Measuring Cards

NI 9213 high speed module:

- 16 channels
- Maximum sample rate 75 S/s
- Supports standard thermo-sensor types (J, K, S...)

NI 9214 precision module:

- 16 channels
- Measurement accuracy up to 0,45 °C
- Supports standard thermo-sensor types (J, K, S...)



Source: National Instruments



Computer-Tomograph for Component Analysis (μm -Range)

Ray Scan 200

- 2D and 3D material and structure analyzes
- Microstructure analysis
- Defect analysis
- Measuring tasks

Specifications:

- X-ray source: Micro focus 10-250 kV
- Burning spot: 3-250 μm
- Object dimensions \varnothing / H: 1-600 mm / 1-1500 mm
- Max. Object weight: 80 kg
- Active area detector: 410 x 410 mm²
- Detector Pixels: 1024 x 1024 (2048 x 2048 optional)
- Digitization: 16 bit
- Measurement time incl. Reconstruction: 2 - 30 min.
- Detectability: 1 μm
- Contrast: <1%
- Operating modes: 3D-CT and radioscopy



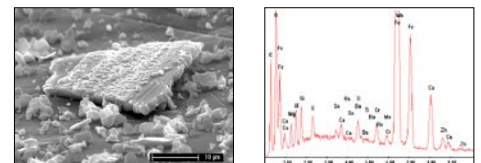
Scanning Electron Microscope with Element Analysis

JEOL JSM-6610 + EDX

Analysis of physically and chemically properties of components in nm-range

Specifications:

- Resolution of 3 nm at 30 kV
- Large sample chamber (350x340x230) mm with fully motorized sample table and a max. sample weight of 5kg
- Samples with a diameter of up to 208mm can be approached at any surface point
- Low-pressure operation with BSD allows high resolution
- Integrated element analysis (from boron to americium)



- 30 mm² active detector area
- Gold / Carbon sputter system



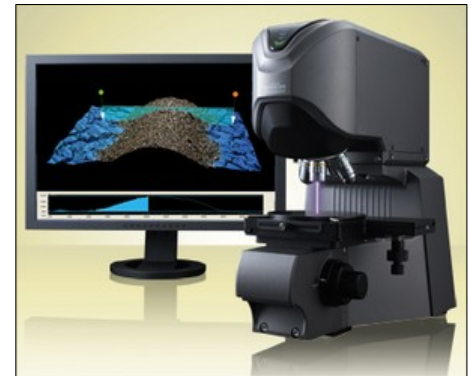
Laser Scanning Microscope

Keyence VK-X 3D-Laser Scanning Colour Microscope

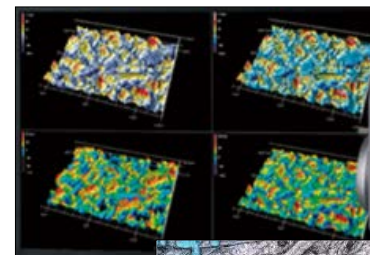
Surface analysis of tribologically stressed surfaces, roughness and ripple determination, 3D analysis of seals or friction linings and particle size determination

Specifications:

- Red semiconductor laser with a wavelength of 658 nm
- More than 3 million measurement points in each level
- 16 bit PMT, color CCD image sensor (3072 x 2304)
- 5 nm high resolution
- 8x optical zoom (laser mode)
- Scanning speed up to 120Hz
- XY image composition module with software and travel table (motorized 100x100mm)
- Comprehensive evaluation and analysis software
- Large number of different lenses



Source: Keyence



High Speed Digital Microscope

Keyence VW 9000

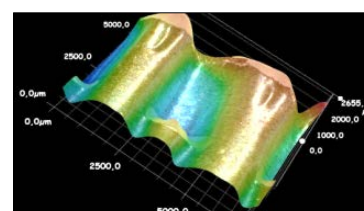
- Analysis of highly dynamic processes in the micrometer range
- 3D measurement of surfaces

Specifications:

- 4000 fps at 640x480 pixels
- Max. 230000 fps
- Microscope up to 1920x1440 pixels
- Magnification up to 200 times
- Macro zoom lens for long distance



Source: Keyence





Measuring Arm with Probe and Laser Scanner

FARO Fusion + Laser Line Probe

- 3D measurement of components, interior and body
- 3D modeling and reverse engineering
- Positioning and calibrating in the room
- anthropometry

Construction: 2,4m / 7 axes

Accuracy tactile: 51µm

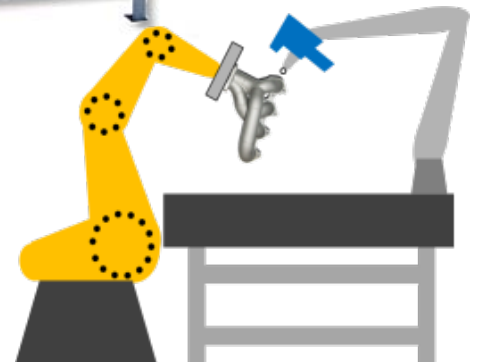
Accuracy optical: 35µm



Measurement Table

Measuring Plate DIN 876/000

- Size of the table: 1500x1000mm
- Surface area: 2.5 µm
- Surface diamond lapped
- Corrosion-resistant and acid-resistant
- Hardness: 6 - 7 (Mohs hardness)
- With threaded inserts in the table surface





3D Midrange Laser Scanner

FARO Focus 3D X 330

- Surveying and verification of industrial plants and installations
- Testing of large moldings and components
- Architecture and terrain surveying

Range: 0.6m - 330m

Systematic error: +/- 2mm

Specialties: - Integrated GPS-receiver -
- Scanning in direct sun light

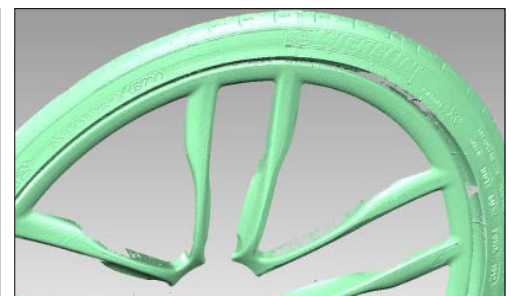
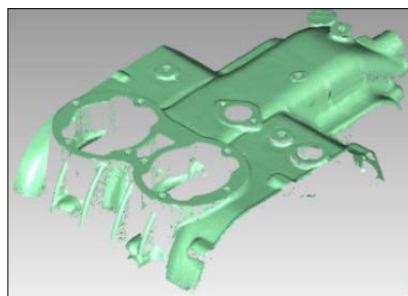
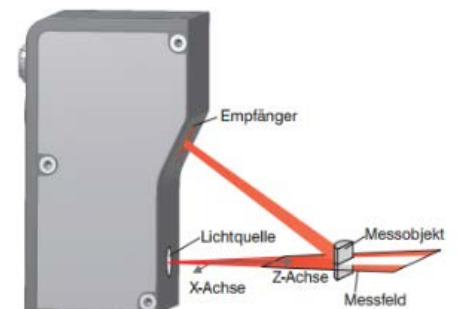


Source: FARO

Laser Line Scanner for Geometry Detection

Micro Epsilon ScanControl 2750 – 100

- Max. Profile sampling rate (test surface depended): 4000 Hz
- Typical profile sampling rate: 500Hz
- Component vibrations can be detected
- Measuring distance: approx. 500 mm
- Profile width: approx. 100mm





Wheel Alignment System

Beissbarth ML 8 R easy +Hydraulic Ramp Nussbaum UNI-Lift 3500 NT Plus

- Extensive database with setpoints of vehicles
- Measurement of individual wheel position variables
- Runout compensation
- Wheel sizes up to 24 "
- 4 measuring heads with 2 infrared cameras each
- Load capacity: max. = 4000 kg (wheel free lift 3500 kg)
- Wheelbase: max. = 4050 mm
- Width: max = 2120 mm



Robotic Handling Systems

Precision Positioning Robot

- Precision positioning robot
- Max. Payload: 34 kg
- Robotic weight: 248 Kg
- Brakes: in all axles
- Max. Speed in the center of gravity: 10.3 m/s
- Operating distance: 710 mm
- Degrees of freedom: 6
- Repeatability (typical): $\pm 0.01\text{mm}$
- Repeatability (ISO 9283): $\pm 0.05\text{mm}$
- Programming language robot control: VAL3
- Self-developed Labview interface



Source: Staubli



Actuation Robots

Pedal Actuator

- Reproducible pedal operations with high dynamics and precision
- Static and dynamic measurement of the pedaling properties and associated vehicle reactions

Principle: Servo-hydraulic
Limits: $F = 0 \dots 1500 \text{ N}$
 $v = 0 \dots 1000 \text{ mm/s}$
Modes: Force controlled,
 Length controlled,
 Ramped actuation,
 Oscillated actuation,
 Measurement while driving possible
Data collection:
 Pedal force, actuation path,
 Hydraulic pressure,
 BKV-pressure,
 Vehicle velocity,
 Vehicle deceleration



Stähle Autopilot SAP2000

Autopilot for computer controlled testing of Vehicles on the roller test stand

Advantages:
 No driver necessary
 Highly accurate and reproducible
 Coupling with the dyno controller possible
Limits: Force acceleration pedal: 100 N
 Force brake pedal: 350 N
 Force clutch pedal: 250 N
 Force Gearshift: 250 N
Accuracy: $\pm 1 \text{ km/h}$





Pressure Measuring Mat

Tekscan TVR8404

- Analysis of pressure distribution of car tires in wheel-to-ground contact
- 36.608 piezo-resistive sensors on a surface of 268 mm x 317 mm allow the recording of the surface pressure distribution in the tire
- Recording frequencies of up to 106 Hz allow the measurement of dynamic processes during rolling
- Extensive analysis software



Highly Dynamic Force and Vibration Measurement System

Kistler Vibration Measurement System

- Determination of the dynamic force at the vehicle chassis connecting points
- Recording of oscillating forces and moments with up to 16 sensors

Specifications:

- Range: $\pm 100 \dots 1\,000\,000$ pC
- Frequency range: 0 – 45 kHz
- Drift: max. 0,2 pC/s
- Measurement uncertainty: <1%
- Measurement signal: 0-10V
- Storage of the measuring signals by direct reading of the measuring amplifiers (via Ethernet)





Wheel Load Sensor

Kistler RoaDyn S635

- Highly dynamic detection of wheel forces and moments
- 6-component wheel force sensor allows the measurement of multi-axis loads
- Complete assembly of the measuring wheel on the vehicle (as replacement for the standard wheel)
- Mounting on the tire trailer for the analysis of the behavior of the tire / road contact
- Mounting at the corner-module test stand for the analysis of the behavior under laboratory conditions



Measurement Range:

| | |
|--------|---------------|
| Fx | -35 ... 35 kN |
| Fy | -20 ... 20 kN |
| Fz | -35 ... 35 kN |
| Mx/y/z | -5 ... 5 kNm |

Emission Analysis Systems

HORIBA MEXA – 2100 SPCS and SMPS

- Solid Particle Counting System (CPC) + Scanning Mobility Particle Sizer (SMPS)
- Enlargement of the surface of the particles by heterogeneous condensation makes optical detection possible (the particles are passed through saturated alcohol / n-butanol)
- Counting by means of optical scattered light detection

Specifications:

- Particle count range: 10 - 2500nm (CPC - modified)
- Dilution Factors: 150: 1 - 3,000: 1 (two dilution steps)
- Size distribution by SMPS: 2.5 - 150nm and 10 - 1000nm over 167 channels



Source: HORIBA



AVL M.O.V.E

Mobile Exhaust Measurement Systems

- **GAS PEMS iS:** The AVL GAS PEMS iS is a compact, portable exhaust-gas analyzer developed for the determination of NO / NO₂, CO / CO₂ and O₂ concentrations in the exhaust gas of diesel and gasoline engines
- **PN PEMS iS:** The PN PEMS iS has been developed for continuous measurement of particulate matter emissions [# / cm³] of solids particles under real driving conditions (RDE)



Source: AVL

Specifications:

- Sensor principle: Advanced Diffusion Charger
- Sample preparation: Catalytic Stripper
- Max. Sampling rate: 10Hz
- Dilution rate 10: 1



CAMBUSTION DMS500

Differential mobility analyser (DMA)

Function:

- Particles are charged by an unipolar corona charger with relation to the particle surface
- In a classifying unit the electrically charged particles are exposed to a static electric field, which leads to deflection in direction of 22 ring electrodes
- The trajectory (impact location on a ring electrode) depends on the electrical mobility of the particles, based on which the aerodynamic diameter is estimated

Specifications:

- Range: 5 – 1.000nm (optional: 5 – 2.500nm)
- Max. sampling rate: 10Hz
- 38 size fractions



Source: CAMBUSTION



DEKATI ELPI+

Electrical Low Pressure cascade Impactor (ELPI)

The ELPI + provides real-time measurement of particle size distribution and particle number concentration within a size range of 6 - 10,000 nm. In addition the measuring system is suitable for measuring the particle charge distribution and for gravimetric impact measurements.

Function:

- Particles are charged by unipolar corona charger
- Size-selective fractionation of the particles in a cascade impactor with 14 electrically isolated isolation stages (5 separation stages in the range of PM0.1)
- Collection of the particles with the possibility of a subsequent gravimetric, chemical-analytical or electron microscopic (e.g., SEM) analysis
- Electrical determination with electrometers

Specifications ELPI +:

- Measuring range: 6 - 10,000nm
- Max. Sampling rate: 10Hz
- 14 size fractions / impactor stages



Source: DEKATI

DEKATI Thermodenuder

Application for the removal of volatile and semi-volatile substances in aerosol streams, which can eliminate unwanted transformation effects in the sample.

Specifications ELPI+:

- 10 – 20 l/min sample rate
- Heating up to 300 °C



Source: DEKATI



Opel Ampera

Vehicle with Range Extender for the Examination of drive concepts

- Maximum power: 111 kW / 150 hp
- Max. Torque: 370 Nm
- Vmax: 161 km / h
- 0-100 km / h: <10 sec
- Empty weight: 1732 kg
- Electric drive: 54 kW generator
- 16 kWh battery
- 40-80 km range



Range Extender: 4 cylinder Otto engine, 1398 cm³
63 kW/86 hp at 4800 rpm
>400 km range

Mitsubishi i-MiEV

- Vehicle with electric drive
- Investigation of drive concepts
- Investigation of HMI

Power: 49 kW/67 PS Range: 150 km
0-100 km/h: 15,9 s Empty weight: 1110 kg
Vmax.: 130 km/h
Capacity: 16 kWh



Land Rover Range Rover Evoque

- Vehicle with dynamic tire pressure control, semi-active suspension and decoupled braking system with continuous wheel-slip control
- Examination of driving dynamics

Power: 110 kW/150 PS
Inertia: 380nm
Vmax.: 182 km/h
Empty weight: 2275 kg
Tire size: 235/55 R19





Ford Focus RS

- Investigation of novel thermo-sensors
- Driving dynamics investigation

Max. power: 257 kW/350 PS
Max. inertia: 470 Nm
Vmax.: 266 km/h
0-100 km/h: 4,7 s
Empty weight: 1529 kg
Drive train: 2,3l EcoBoost Otto engine
TwinScroll turbo charger
RS-Dynamic Torque Vectoring



Audi A5 Sportback

- Man-machine interaction (e.g., pedal feel characteristics)
- Brake-by-Wire

Model series B8

- Otto engine, displacement: 1984 cm³
- Power: 155 kW / 210 PS
- Max. Inertia: 350 Nm
- Acceleration: 0-100 km/h: 6,4-7,9 s
- Empty weight: 1590 kg
- Vmax: 241 km/h





Tire Measurement Trailer

- Developed by division of automotive engineering
- Analysis of the adhesion behavior of tires on dry and wet roads
- Electro-servo-hydraulic brake system for the realization of brake slip
- Measurement and control of the braking system using LabVIEW Realtime (Real-Time System CompactRIO)
- Highly dynamic force and torque recording
- Defined adjustment of wheel position variables
- Great variation of wheel loads
- Highly dynamic tire inflation pressure system



Segway i2 / Segway x2 (Off-Road)

- Investigation of near-field mobility solutions for persons with a handicap

Power: 5 kW
Vmax.: 20 km/h
Range: 15-40 km
Empty weight: 48-55 kg



Automotive Engineering

4. Software Applications

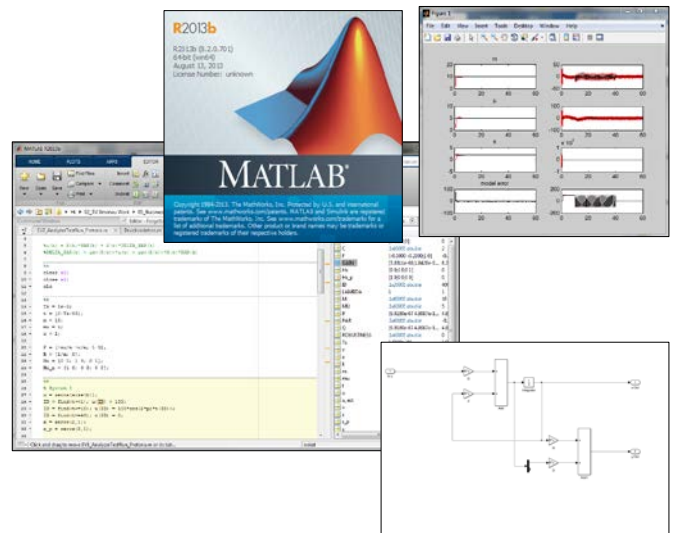


MATLAB/Simulink

Computer-algebraic solver for differential equations

Application:

- Data collection and data analysis
- Rapid Control prototyping and optimization
- Prototypical software development
- Statistics, signal and image processing
- (Co) Simulation



InMotion

Mobile real-time simulation platform with multivalent interfaces:

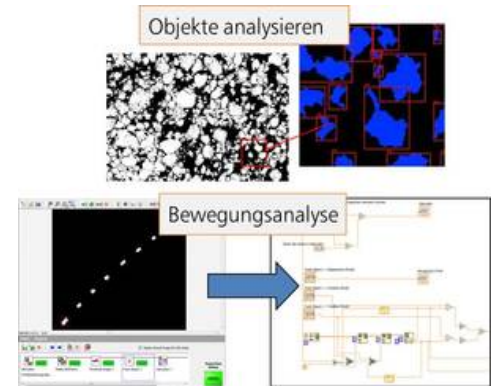
- Interfaces to MATLAB / Simulink, C-Code
- Communication interfaces: UDP / IP, TCP / IP, CAN, FlexRay, USB
- Application: Complete vehicle simulation (IPG CarMaker) for the representation of complex test scenarios through real-time networking





IMAQ

- PC-based image processing
- Online and offline image analysis
- Automated image analysis using sequences
- Automatic testing of dimensional and positional deviations
- Interface to LabVIEW



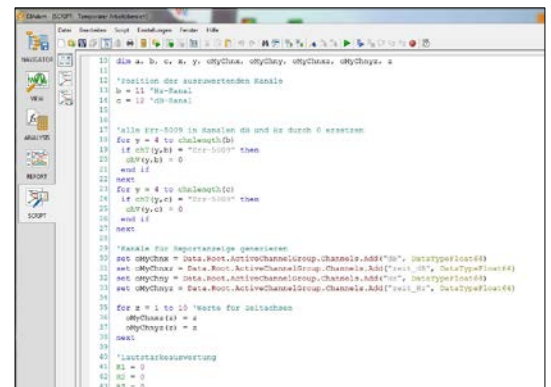
IPG CarMaker

- Virtual vehicle testing in the pre-development stage
- Possibility to implement driver and vehicle models (or even individual subsystems) and related regulations
- Application: Simulations for preliminary investigation of new concepts and newly developed control systems



Diadem

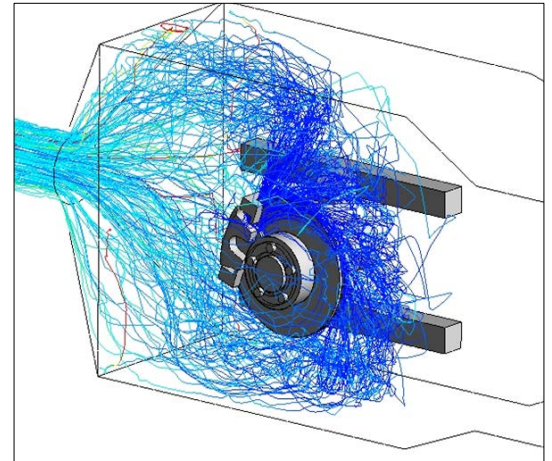
- Creation of applications for measurement data recording
- Automated data analysis with DIAdem script
- Application: data acquisition, data evaluation





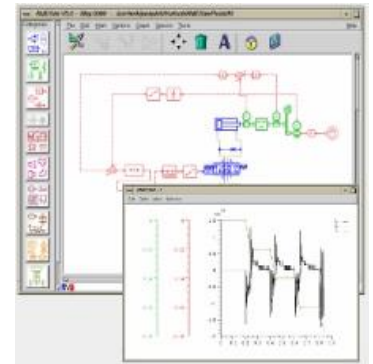
ANSYS

- FEM software for linear and non-linear problems in the fields of structural mechanics, structural dynamics, fluid mechanics, thermodynamics, piezoelectricity, electromagnetism and combined approaches
- Application: NVH analysis / analysis of aerosol flows (fine dust emissions) / friction simulation in automotive vibration dampers



AME Sim

- Simulation of hydraulic and pneumatic systems, signal processing, fluid and heat transfer coupling
- Application: Unsteady system simulation of electrohydraulic braking systems



LabView

- Software for system development used in measurement, test, control and regulation applications
- Fast hardware access with fast insight into data
- Creation of real-time applications for measurement data and controlling processes
- Creation of executable programs in customer order (stand alone applications)
- Application: Data acquisition and control of automated systems

