



**POLITECNICO**  
MILANO 1863

DIPARTIMENTO DI MECCANICA

# LaST - Laboratory for safety of transport systems

## Ground vehicle design and testing, focusing on active safety

### Description:

Main activities of the Laboratory involve testing and modelling of vehicle systems with emphasis on suspension systems, tyres, braking systems, drivelines of conventional or electric vehicles. NVH, durability, thermal and mechanical performances are derived either experimentally or by numerical simulations. The measurement of the parameters affecting the vehicle dynamics, e.g. vehicle inertia properties, is performed by original and dedicated test rigs. Patented load cells and measuring hubs are available. The measurement and simulation of vehicle ride comfort is one of the key competences of the Laboratory.

### Certifications:

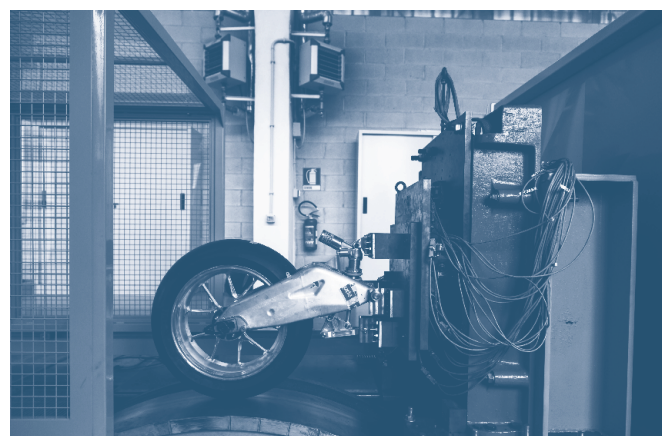
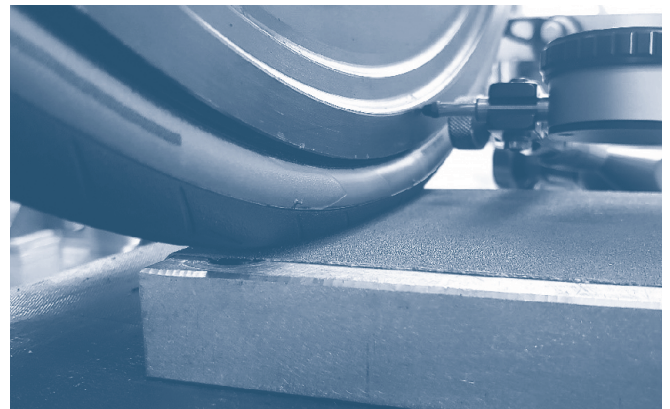
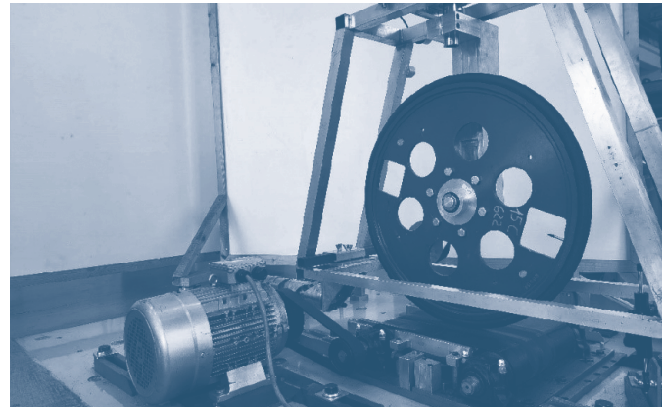
Measurement of the mass properties of a rigid body by means of InTensino. ISO 9001:2008.

### References:

Brembo, Daimler, Evobus, Fiat Powertrain, Ferrari Automobili, Fiat Chrysler Automobiles, Ford USA, Honda RD America, IDIADA, IVECO, Lamborghini Automobili, Maserati Automobili, SameDeutz-Fahr, Toyota Motor Europe.

### Instruments & Facilities:

- InTenso test rig: measurement of the mass properties of full vehicles.
- InTensino test rig: measurement of the mass properties of rigid bodies up to 400 kg.
- RuotaVia test rig: twin drum providing a rolling contact surface for tyre or suspension or driveline test and development.
- Measuring hubs: measurement of the forces acting at the tyre contact patch.
- (Special patented) 6 axis load cells: measurement of forces for



NVH or durability purposes.

- MaRiCo dummy: objective measurement of the ride comfort of vehicles.
- BRAD: measurement of the forces acting both at the brake and at the tire-ground interface.
- VeTyT (Velo Tyre Test rig) for the mechanical characterisation of bicycle tyres.

#### Activities:

InTenso+

- Measurement of the Centre of Gravity location of full vehicles.
- Measurement of the Inertia Tensor of full vehicles.

The rig is composed by a 'carrying system' (usually a steel cage), which bears the body under test; three rods connect the carrying system to an external fixed frame. The rods are connected to the frame and to the carrying system by low-friction Hooke joints. A load cell is fitted on each rod. The orientation of the rods is measured by means of 6 absolute 17 bit encoders positioned on the upper Hooke joint. The Centre of Gravity location and the Inertia Tensor are computed knowing the angular acceleration of the carrying system and the forces acting on it.

InTensino+

- Measurement of the Centre of Gravity location of rigid bodies up to 500 kg.
- Measurement of the Inertia Tensor of rigid bodies up to 500 kg.

The rig is composed by a 'carrying system' which bears the body under test; three rods connect the carrying system to an external fixed frame. The rods are connected to the frame and to the carrying system by low-friction Hooke joints. A load cell is fitted on each rod. The orientation of the rods is measured by means of 6 absolute 13 bit encoders positioned on the upper Hooke joint. The Centre of Gravity location and the Inertia Tensor are computed knowing the angular acceleration of the carrying system and the forces acting on it.

RuotaVia

- Design and testing of tyres.
- Design and testing of suspension systems.
- Design and testing of powertrains.
- NVH measurements.

The RuotaVia rig is composed by a horizontal axis steel drum, providing a running contact surface for wheels. An asynchronous motor+neuro controlled inverter drives the drum up to 400 km/h.

Measuring Wheels/Hubs

- Measurement of the forces acting at the tyre contact patch, custom design.

The measuring hubs are based on a statically determined three cantilever/spoke structure replacing the wheel centre. Strain gauges are fitted on each spoke. The statically determined connection consist of three spherical joints with an additional degree of freedom along the axis of the spokes. A telemetry system has been designed and employed to transmit the force signals to a data storage unit.

Instrumented Steering Wheel

The Instrumented Steering Wheel can measure the forces and the moments applied by the driver at each hand. The ISW has a carbon fibre

composite structure and is equipped with two special six-axis load cells. Six force transducers are placed inside the handles to detect the grip forces exerted by each hand.

MaRiCo Dummy

- Objective measurement of vehicles ride comfort.
- Comparison between different seats.

The dummy can reproduce the vertical and longitudinal accelerations at the body-seat interfaces that would be respectively sensed by a human subject. It can be adjusted to simulate different human subjects, from 5 percentile to 95 percentile, and to accommodate to different seats configuration. The dummy has a vibrating mass moving along the spine axis. An adjustable magnetic damper controls the motion of such a mass.

BRAD

The test bench is composed by a rotating steel drum, which provides a rolling contact surface for a pneumatic tire. The brake under test is connected to the pneumatic tyre spindle. The vertical load is applied to the wheel and brake by means of a pneumatic spring. A two-stage flywheel configuration has been chosen. The test rig can be used to study the interaction between brakes and tires near wheel locking.

VeTyT

- Measurement of lateral force.
- Measurement of self-aligning torque.

The VeTyT can be employed to test a wide range of bicycle tyres with different wheel sizes, from 16" to 29" diameter. The system consists of a rigid frame that allows a wheel to be steered and cambered. Tests can be performed either on a drum or on a flat surface.

