MICRO-EPSILON

Profile sensor for tire measurement on the test rig

Tire properties are crucial for safety, driving response and comfort in modern automobiles. To ensure constant quality at the highest level 100% inspection of tires is already required in production. Apart from dynamic stress tests, the acquisition of bulges, constrictions and impacts is of primary importance.

To ensure short cycle times on the test rig, the measurement can only take place on a non-contact basis, i.e. the sensor is not in direct contact with the tire. Previously, principally capacitive sensors or laser point sensors were employed for such non-contact measurements.

The capacitive method detects over a relatively large measurement spot. Consequently, patterns impressed on the side walls of the tires - such as legends and symbols - cannot be differentiated from faults such as bulges.

With laser-based optical point sensors the high spatial resolution and the high measurement rate render a computerized compensation of the legends and symbols possible, but due to the comparatively long cycle times, generally the measurement is restricted to one or two tracks. This leads to bulges and recesses with small spatial dimensions not being acquired.

The innovative solution for tire measurement is the profile sensor, scanCONTROL 2800. The measurement does not occur point-shaped, but rather along a laser line on which many points are acquired. This corresponds to a measurement setup using many laser point sensors.

2D sensors previously available on the market were noticeably too slow for measurements on tires or had problems with the reflection properties of freshly produced tires. The profile sensor, scanCONTROL 2800, gives measurement rates with up 2000 profiles per second - which shortens the complete measurement time for tires to under one second.

Just as important is the very good measurement behavior on black rubber surfaces. The highly sensitive CMOS array, specially developed for scanCONTROL, facilitates measurements almost independent of the reflection of the target. So even at the highest measurement rates excellent accuracy and resolution are achieved.

Bulge on the tire - visible on the laser line

Sensor and tire on the test rig

scanCONTROL 2800: sensor and controller

Tire inspection sequence:

The tire is automatically passed to the test rig, held and mounted. Subjected to approx. 4 bar tire pressure, the tire is then rotated by 360° (approx. one revolution per second). During this rotation three profile sensors check the complete tire for possible fault locations, i.e. for impacts, bulges and constrictions. Using the same mounting, further inspection steps, such as dynamic force application, can be carried out.

Measurement system requirements:

- Measurement range in the Z direction (depth): approx. 200 mm
- Measurement range in the X direction (width): approx. 50 mm
- Large base distance: approx. 230 mm (safety distance to prevent damage to the sensor due to bursting tires).
- Resolution in the Z direction: approx. 15 µm
- Dynamic response:
  500 profiles/sec each with 250 measurement points (Laser Class 2)
  1000 profiles/sec each with 128 measurement points (Laser Class 3a)
  2000 profiles/sec each with 64 measurement points (Laser Class 3a)

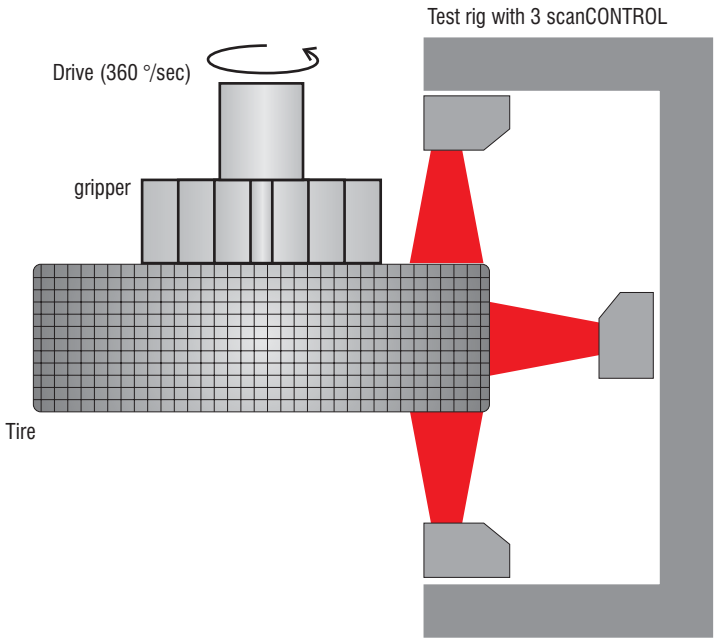
Decisive advantages of the measurement system:

- Profile instead of point measurement.
- High accuracy and reliability.
- Highest measurement rate.
- Up to 500 Hz Laser Class 2.

System set-up

The measurement system consists of three sensors of type LLT2800-100 and a controller. The data are output from the controller via IEEE1394 (Firewire) in the DCAM format. Drivers for integration into customer-specific programs are available. The evaluation software on the test rig was realized by the customer.

Principle



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