Railway and Trains Monitoring

VTT TECHNOLOGY

Railway health monitoring enables early detection and warning on tracks requiring service and repair before critical faults occur.

SOLUTION

The WSN collects information on structural health and behaviour of railway infrastructure, and transmits it to the data server enabling remote monitoring. VTT has also developed a completely wireless system for train wagon collision testing. The main parameters to measure during the collision tests are buffer force, acceleration and deformation on the wagon structure.

IMPACT

The train wagon collision testing system is currently designed according to the European Wagon TSI directive. The system can be mounted in one hour, and needed HW is transportable in two briefcases.

Process

- Specifying measurement needs
- Design of measurement and monitoring system
- Installation of monitoring system and data analysis
- System design and productisation with R&D companies
Railway and Train Monitoring

- **Railway health monitoring**
  - Early warning on tracks requiring service and repair before critical faults.

- **Vibration measurements**
  - Allow to measure the load on the rails without the actual test track

- **Crash tests**
  - Test the buffing impact on the wagon construction
Example: Train axel measurements

- During the introductory phase of the train axel the testing is done in accordance with standard to test the load exerted by the axel lines.
- An embedded wireless measurement system was installed on the bogies, which includes 4 wheels x 20 strain half-bridge, 2 kHz sampling, pre-processing and wireless communication.
Crash tests
System design data

- VTT has developed a completely wireless system for train wagon collision testing
- The system is currently designed according the European Wagon TSI directive
- This directive describes the testing procedure for wagon testing
- The main characteristics to be measured are:
  - Buffer forces, acceleration and deformation (force) on the wagon structure
Cables installation: old system
Technical details (1/2)

- The system includes following components:
  - Buffer forces: 4 measurement units, based on strain gages
  - Acceleration: 2 sensors, based on accelerometers
  - Force sensors: on wagon body: up to 8 measurement that can be placed anywhere on the frame of the wagon; strain gage impedance from 120 ohms to 1 kohm
  - Two light diodes which are measuring the collision speed and triggering the measurement
  - One transceiver with USB connector: Connects the system to any portable PC with Windows operating system and changes this PC to a testing device (with application software).
Collision testing system: Components & layout

**Buffer force:**
- antialiasing filter: RC
- A/D-conversion 24bit, 4.8kHz

**Acceleration:**
- antialiasing filter: RC
- A/D-conversion 16bit, 4.8kHz

**Control PC:**
- PC + Communication module (Master)
- GUI
- Measurement control
- Data collections & storage

**In Wagon:**
- 4 buffer sensors, strain gauge: half/fullbridge 120/240 ohm
- 2 1D acceleration: Colibrys/SiliconDesign
- 3 pc:s SensorNode: measurement, processing, transmission
- 1 load sensor, 3D acceleration
- up to 8 deformation sensors (strain gage)

**Light sensor:**
- 2 ps:s
- based on reflectors on test wagon body (two in each)
- triggering the measurement
- speed measurement

---

14/10/2016 8
Buffer Force: Strain Gages
Buffer Force ja Acceleration: sealed and rugged aluminum cases
- Measurement HW: Transportable in two briefcases
- Fast installation: can be mounted in one hour: self powered with rechargeable batteries; 24h operation time with one charging
Additional information

VTT Technical Research Centre of Finland Ltd

Klaus Känsälä
Senior Scientist
Industrial IoT
+358405460131
Klaus.kansala@vtt.fi
TECHNOLOGY FOR BUSINESS