



Needs Tailored Interoperable Railway Infrastructure

Dynamic measurements in Slovenia

NeTIRail-INFRA final conference, Ljubljana – 24th May 2018

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WP2 - Content



- Measuring technologies in Slovenia
- Dynamic measurement technology
- Dynamic measurement equipment
- Dynamic : Geometric measurements
- Dynamic : Corrugation measurements
- Conclusion

Technologies (1)

Measuring technologies in Slovenia

- Measurements with traditional high resolution track monitoring equipment integrated into the train (measuring trains)
- Monitoring technologies, performed with portable measuring equipment on standard vehicles



Technologies (2)



Measuring technologies in Slovenia

- Measurements of the geometric parameters of the lines: stability, direction, cant, twist, gauge (extension, narrowing); calculation of quality parameter KT500
- Rail diagnostics: ultrasonic control of rails, rail wear measurement, rail corrugation measurement, control of rails with Eddy Current (head check)
- Measurements of dynamic track parameters: lateral acceleration, vertical acceleration; calculating the coefficient of derailment
- Visual inspections

Dynamics



Dynamic measurement technology

- Portable measuring equipment, sensors mounted on a bogie of passenger train, measuring system
- Preliminary preparation, calibration, installation, setup file
- Measuring lateral and vertical acceleration
- Calculate average lateral and vertical acceleration, lateral force
- GPS kilometre position of a train

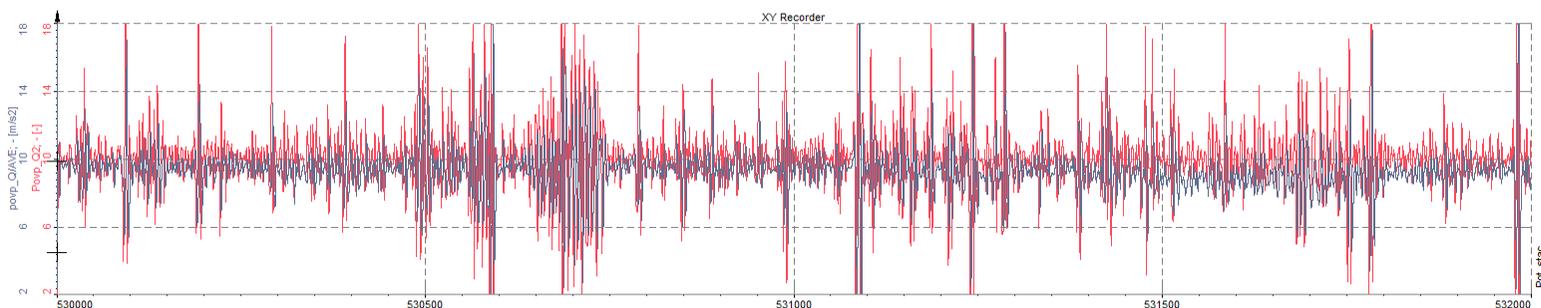


Equipment (1)

Dynamic measurement equipment

- Low frequency accelerometers: four vertical and four lateral accelerometers; Dewesoft, frequency range 80 Hz, sensitivity 30 and 145 mV/g
- High frequency accelerometers: four vertical and four lateral accelerometers; Dytran DC response accelerometer, $\pm 100g$ range, frequency response 0 - 2500 Hz, sensitivity 40 mV/g

→ *difference in detection of vibration frequencies*



Equipment (2)

Dynamic measurement equipment

- Low frequency
accelerometers
Dewesoft

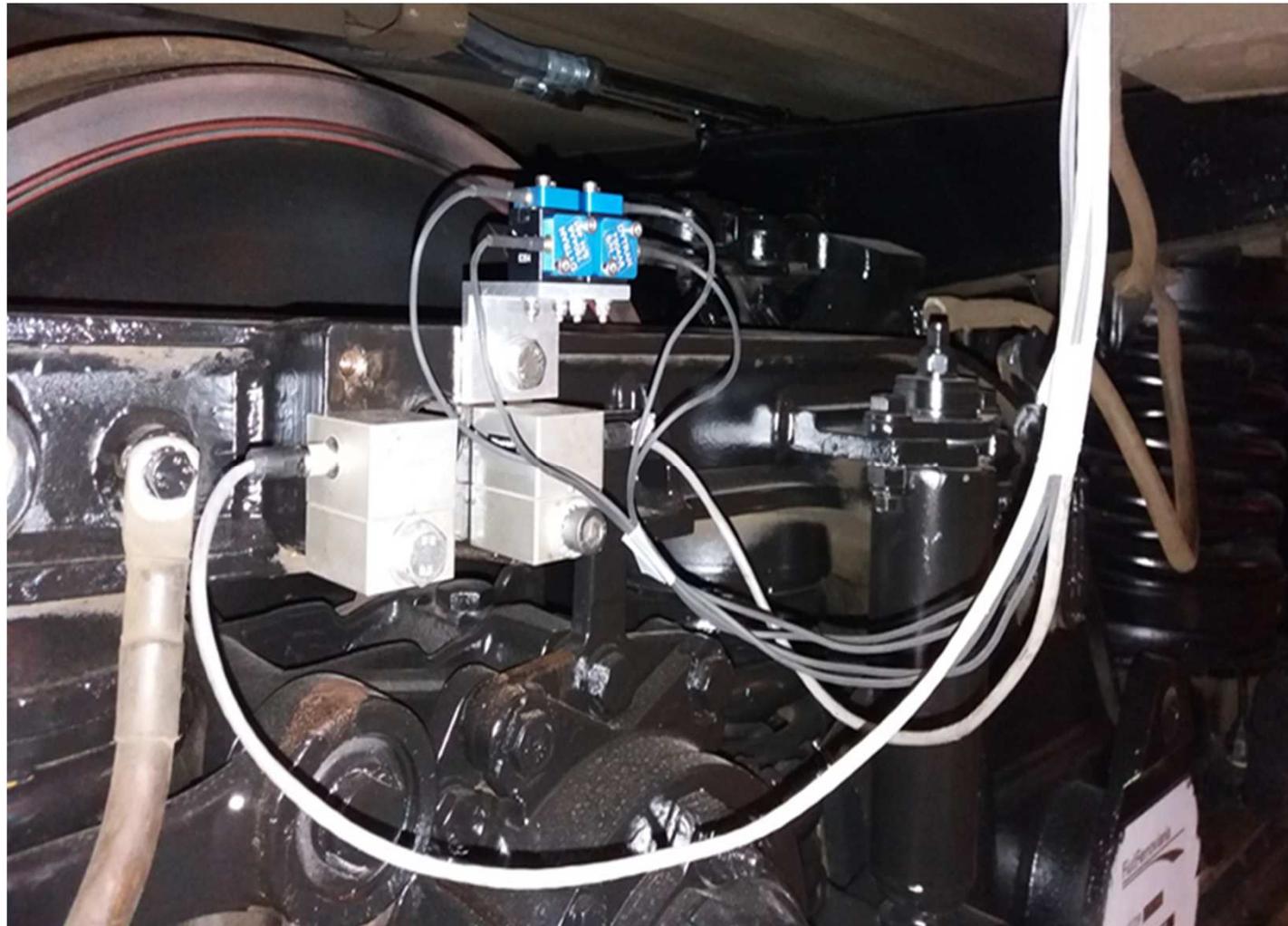


- High frequency
accelerometers
Dytran



Equipment (3)

Dynamic measurement equipment



Geometry (1)



Comparison Dynamic & Geometric measurements

- correlation of lateral acceleration (F) with geometric parameters (D, C)
- **Lateral acceleration : Direction, Cant**
- correlation of vertical acceleration (E) and geometric parameters (A, B)
- **Vertical acceleration : Stability, Twist**

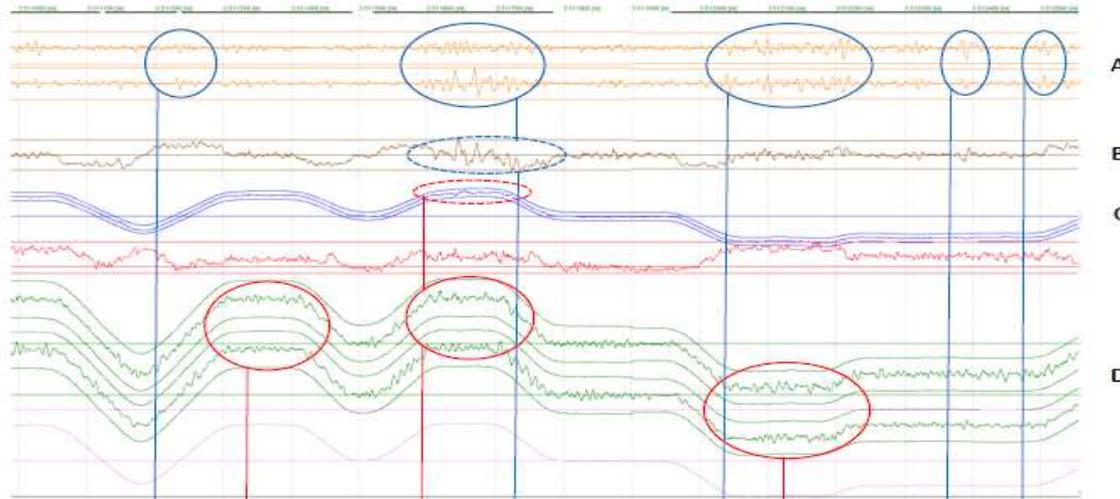


Figure 4-4 Parameters of geometric measurements on 1,5 km section 10L 511.000-512.500 (DrezStac), November 2017.

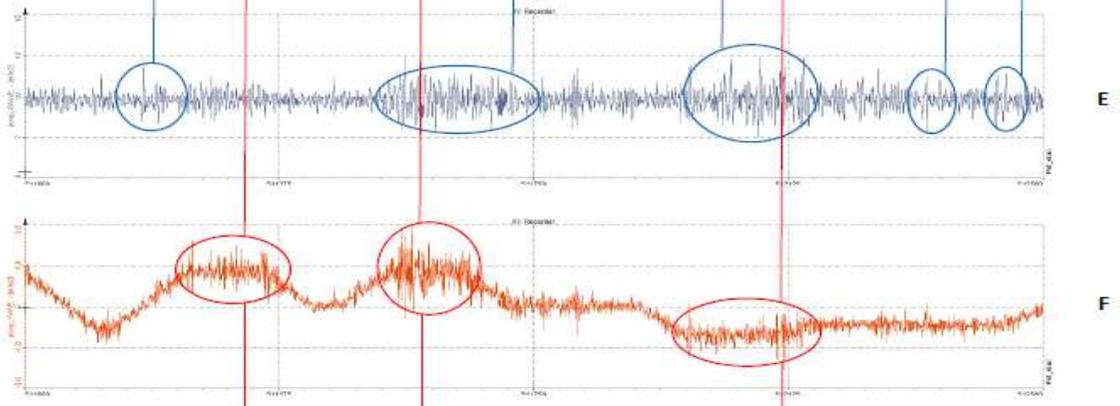


Figure 4-5 Vertical and lateral acceleration on 1,5 km section 10L 511.000-512.500 (DEWESoft), December 2017.

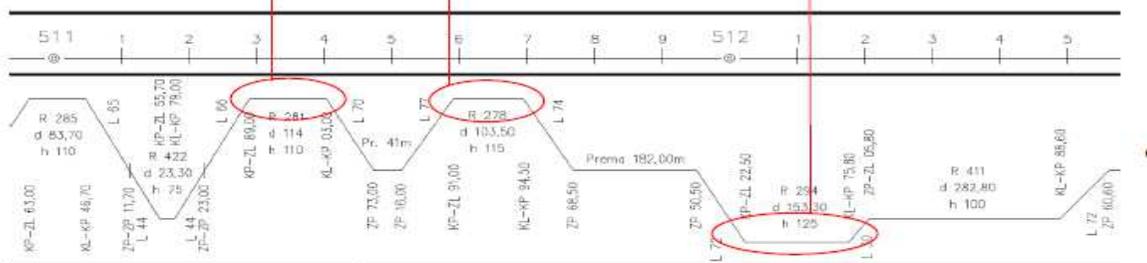


Figure 4-6 Longitudinal profile of 1,5 km section 10L 511.000-512.500.

A – Stability (left and right rail)

B – Twist

C – Cant

D – Direction (left and right rail)

E – Vertical acceleration

F – Lateral acceleration

G – Longitudinal profile

Corrugation (1)



Comparison Dynamic & Corrugation measurements

- correlation of vertical acceleration and track stability
- **Vertical acceleration : Stability**
- track sections with corrugation, on right or left rail
- **Corrugation : Greater difference in vertical acceleration signal - *between high and low-frequency sensors???***

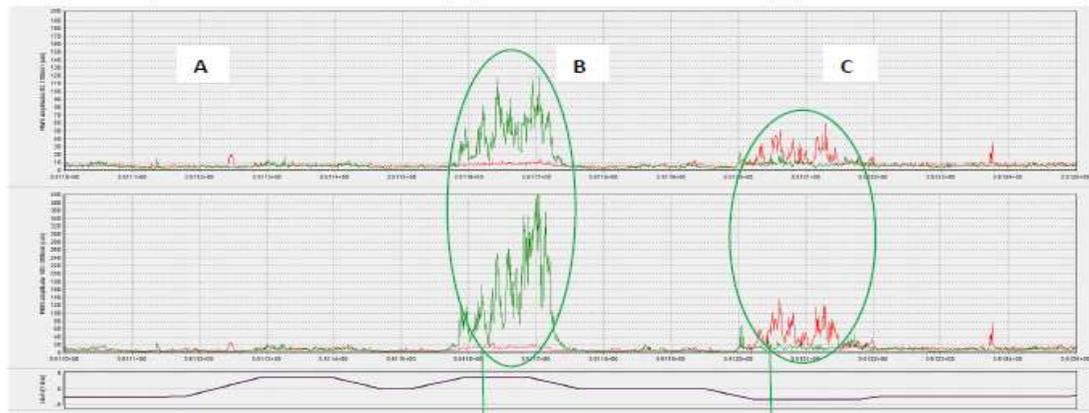


Figure 4-7 Corrugation measurements on 1,5 km section 10L 511.000-512.500 (CorrViewer), red-left rail, green-right rail; August-September 2016.

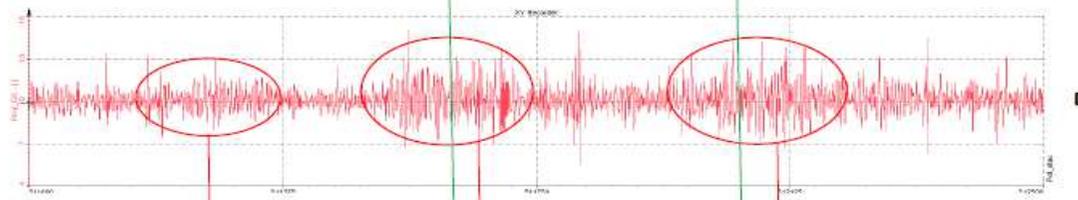


Figure 4-8 Vertical acceleration on 1,5 km section 10L 511.000-512.500 (DEWESoft); December 2017.

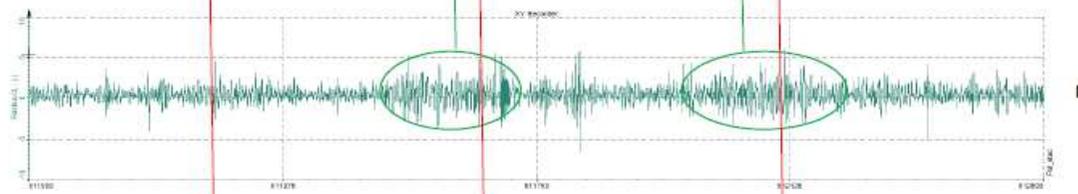


Figure 4-9 Difference in vertical acceleration between high-frequency and low-frequency sensors.



Figure 4-10 Geometric stability on 1,5 km section 10L 511.000-512.500 (DrezStac); November 2017.

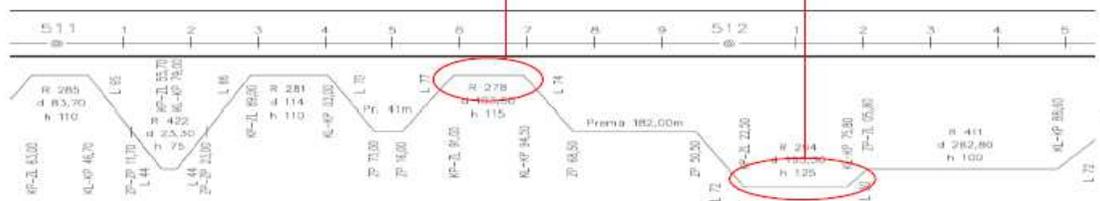


Figure 4-11 Longitudinal profile of 1,5 km section 10L 511.000-512.500.

A – No corrugation

B – Corrugation of right rail

C – Corrugation of left rail

D – Vertical acceleration

E – Difference between high and low-frequency vertical acceleration

F – Stability

G – Longitudinal profile

Corrugation (3)

Comparison Dynamic & Corrugation measurements

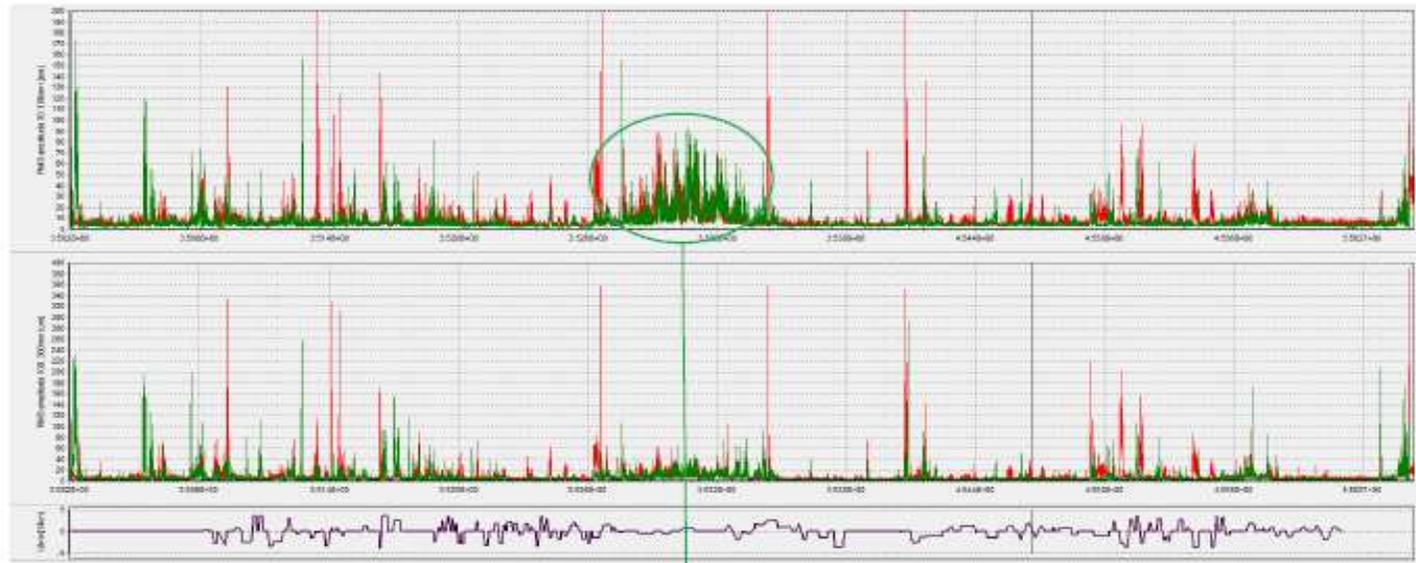


Figure 4-12 Corrugation on rail line 10L state border-Dobova-Ljubljana.

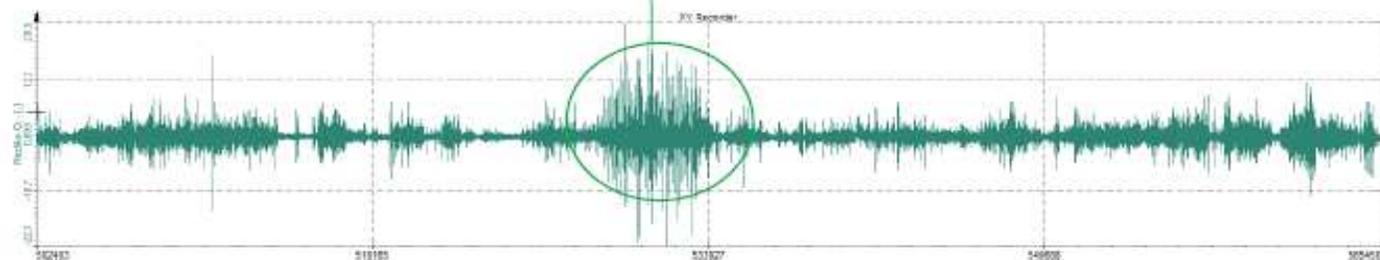


Figure 4-13 Difference in vertical acceleration between high-frequency and low-frequency sensors on rail line 10L state border-Dobova-Ljubljana.

Conclusion



- great reliability on the correlation between dynamic and geometric parameters
- correlation for corrugation with a dynamic vertical parameter, but not so pronounced → sensors should be placed closer to the formation of the corrugation
- **Potential usability of dynamic measuring equipment for "early diagnostics" purposes**
→ *to improve system, additional research, other different sensors tested*



THANK YOU for your attention!

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