Reference track for optimised vehicle design

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(contributions from Vibratec, Bombardier, DB)

Contents

- Why vehicle characterisation
- Design issues for new vehicles
- Maintenance issues for in-service vehicles
- Proposed testing method
- Follow up and implementation

Vehicle performance

New vehicles:

- Reduce unsprung mass
  - Optimize suspension
- Optimize brake system
- Maintain wheels

In service vehicles

- maintain wheels
- maintain suspension

Indicator: receptance

Wheel OOR

In service vehicles

- Currently: monitoring stations, mainly to detect wheel flats (at commercial speed) – mainly freight
- Objective: not only flats but also quality of suspension
- Required:
  - modification of track (possibly low receptance, in order to make the vehicle receptance the dominant one),
  - vehicle and axle recognition system

- Feasibility?

Design process new vehicles

- Client defines maximum vibration level at some distance from the track
- Supplier and client agree on details of track (receptance) and soil (and dwelling)
- Supplier and client agree on model to be applied, required vehicle receptance and compliance test method
- Supplier applies these data in a (simplified) *prediction model* to derive required vehicle receptance
- Designer uses measured receptance of previous vehicles as a starting point and optimizes if necessary
- Supplier carries out compliance test (certified)

Standard track for new vehicle testing

Semi-virtual testing

- Design a track with possibly low receptance (to make the vehicle receptance dominant over a large frequency range)
- Define an optimized receiver point, possibly close (but not too close) to the track
- Assess vehicle receptance on that track
- Input this receptance into a model with real track characteristics and real soil data
- Predict resulting vibration level and compare to client's requirement

Outline D1.8

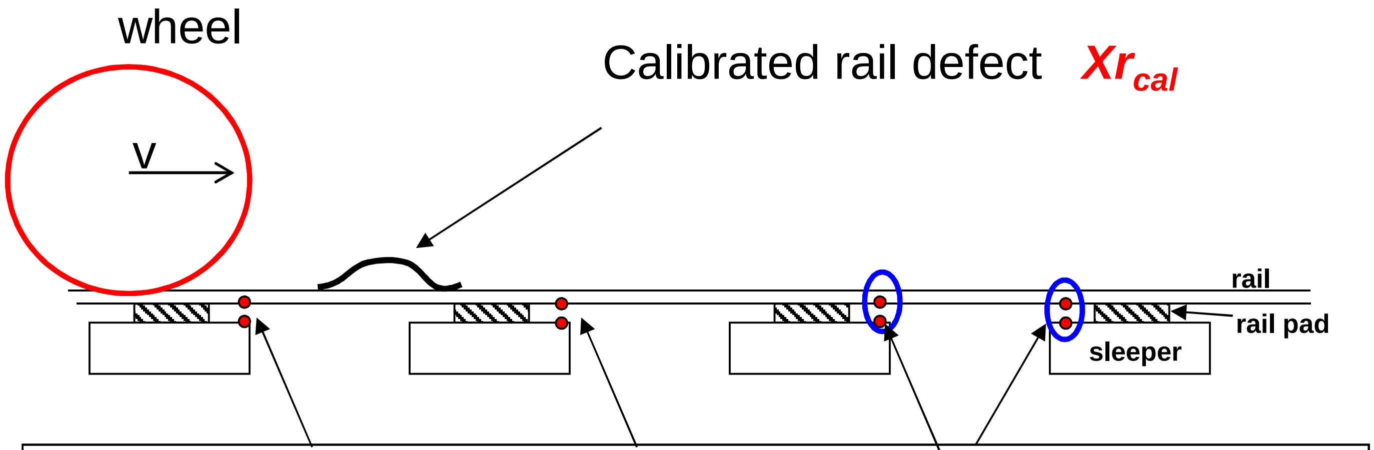
- Why vehicle characterization
- New and in service vehicles (passenger/freight)
- Design process of new vehicles (pass/freight)
- Specifications for vehicle receptance
- Standard track for vehicle testing
- Virtual testing and test track
- Simulation of vehicle test
- In service vehicles

Test track for virtual testing

- Direct method (in a workshop, excite the wheel with a shaker and measure receptance)
- Indirect method (in the "field"; excite the wheel with a prefabricated irregularity on the track)

Indirect measurement of vehicle receptance

$$A_w = Xr_{cal} / F_c - A_r$$



Measurement of rail-pad deflexion + measurement of the sleeper deflexion

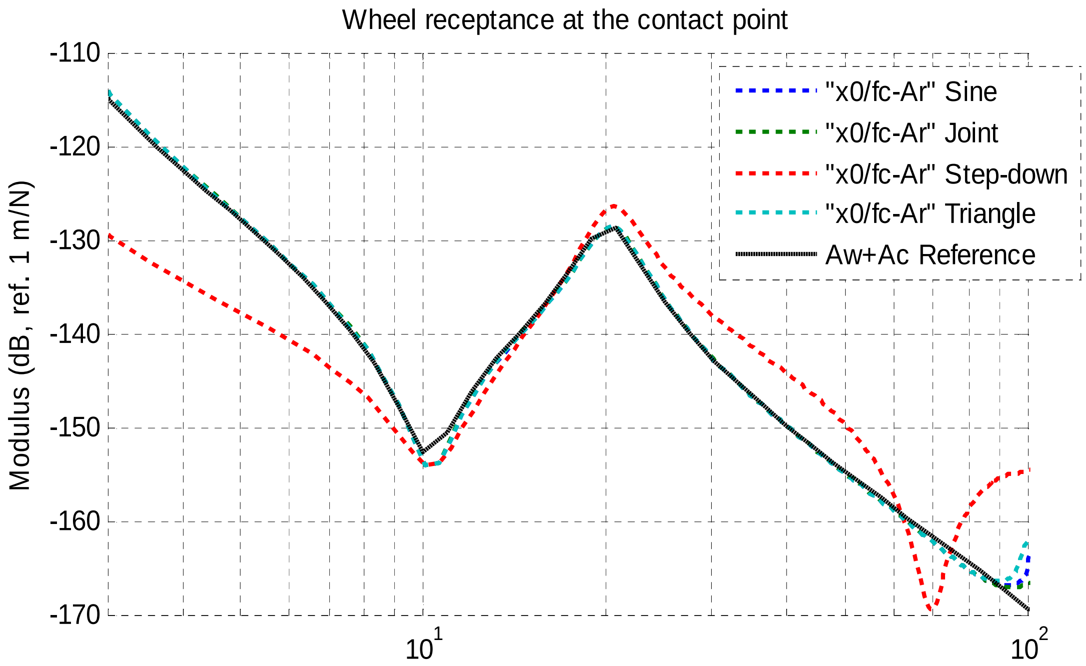
= assessment of the contact force F_c + track impedance seen from the sleeper A_r

Simulation with different shapes

- A rail joint of 6 cm length
- A rail joint together with a step down of 3 cm length and 1 mm depth
- A sine defect of 1 mm height peak to peak with a length of 6 cm
- A triangle defect with a 6 cm length and 1 mm amplitude (easier to manufacture)

- Train speed ≈ 11 kph

Results of different shape simulation



Preliminary conclusions

- Sine and triangle shape are reliable
- 1 mm and 6 cm dimension produce sufficient excitation of the wheel to detect insufficient performance

Future implementation

- Results are promising enough to further develop the method
- Next steps
  - Develop pilot
  - Modify method if necessary
  - Describe the full method, including options for prediction
  - Develop into Good Practice Guide (later certified or even TSI?)