NeTIRail

Needs Tailored Interoperable Railway Infrastructure

Acceleration monitoring system, for plain line and S&C

NeTIRail-INFRA final conference

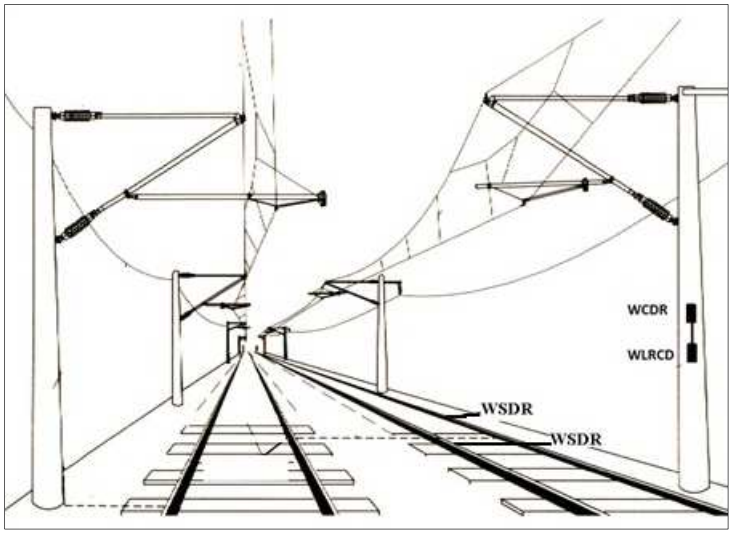
Ljubljana, 24 May 2018

Tudor Popa

Analogic & Digital Systems

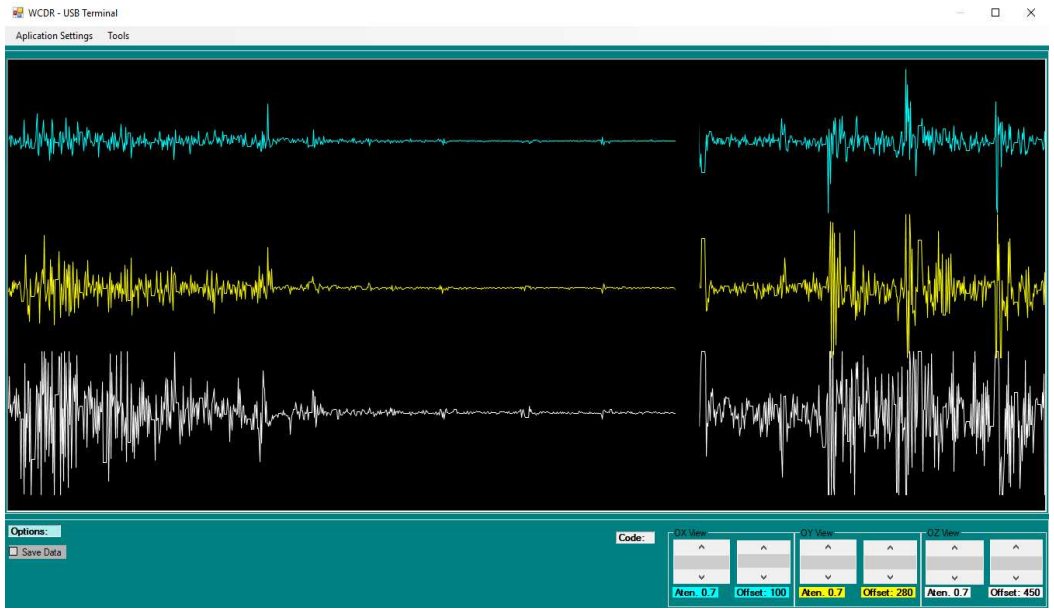
Description of the developed system

Devices types involved in the system



- Vibration presence must be seen as an interaction between vehicle, track and ground; these will influence the vibration amplitudes and frequencies

Terminal Interface for showing and saving data



- User interface (GUI) application will display the values in real time and will save the received message, one message on every row, .csv format

Advantages of the using system (1)

- The developed solution focused equally for plain lines and S&C
- Long time vibration monitoring provide info about wearing degree, through comparing historical data
- The system is in the low cost category and was a very important objective in designing stage
- Maintenance improvement, through helping implementation of the "on-demand" strategy
- Fast detection of critical defects
- Historical and comparative data will help in improvements for the future new track designs
- Useful for wear degree monitoring also, for other sensitive track components (sleepers, clamps, joints, etc.)

Advantages of the using system (2)

Novelty technical characteristics:

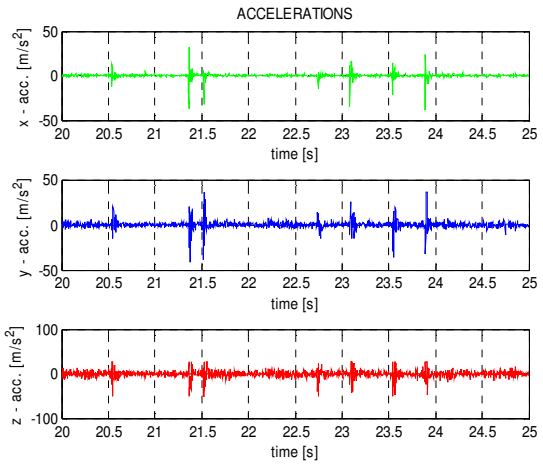
- Wireless communication - there are no wires for data transmission
- Using only one accelerometer circuit for all three axes
- The system is completely autonomous and non-invasive
- Total autonomy, in terms of power supply, using batteries and photovoltaic cells
- Harsh environment functioning

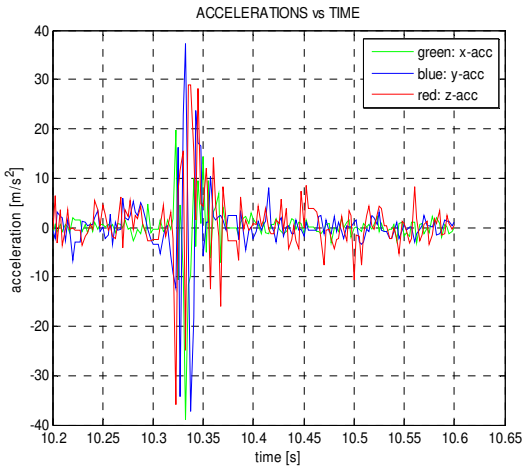
System Settings:

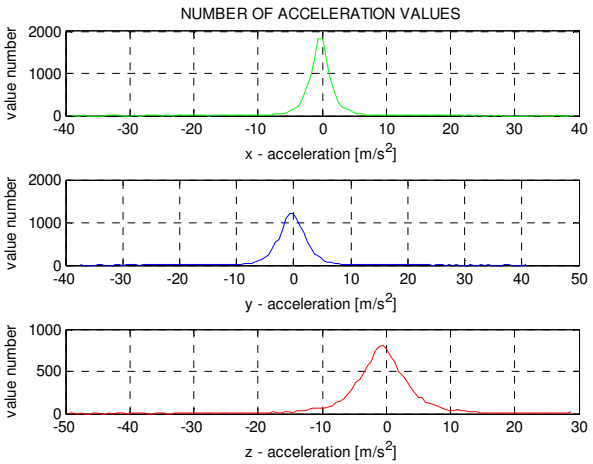
- Sampling rate of the acceleration values is 400 SPS for all axes
- After first experiments were decided acceleration scale at +/- 8g, when wooden sleepers and +/- 4g, for concrete sleepers cases
- The sensor keeps data on its own memory and transmits it after the vibrations are under threshold level; means the train has left the area
- The trigger threshold value for acquisitioning data is +/- 2.5g

Post process functions (1)

- Accelerations amplitudes, on three axes; in time domain
- Acceleration amplitudes as detailed; use narrow time frame
- Distribution on three axis, for accelerations values

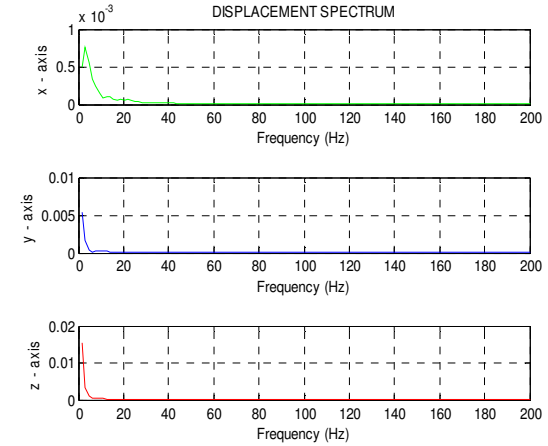


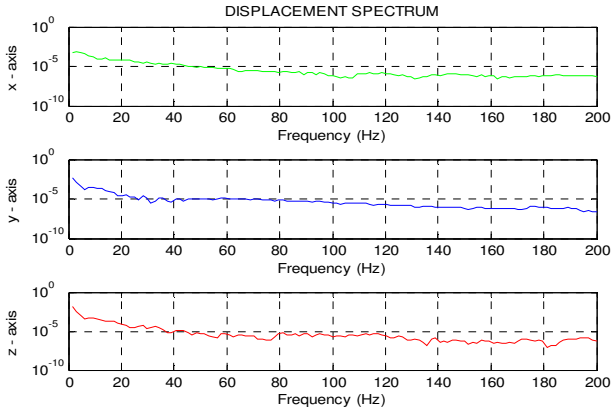


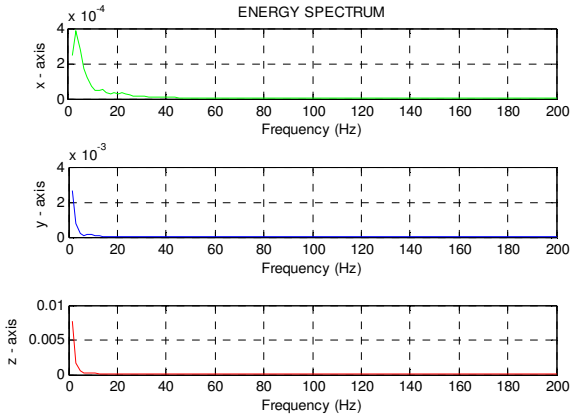


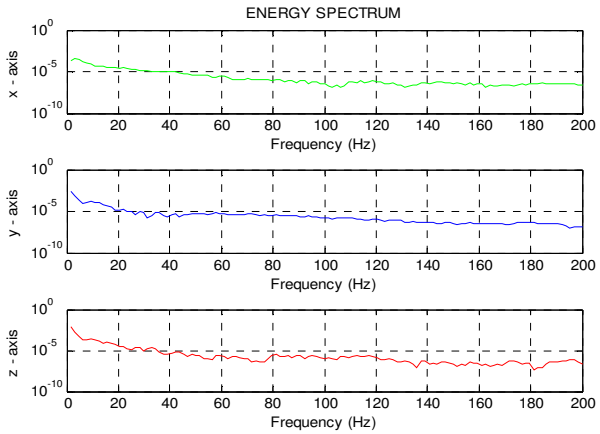
Post process functions (2)

- Displacement spectrum; linear and logarithmic scales
- Energy spectrum all axes; linear and logarithmic scales









Experiment session at RCCF – Brasov (1)

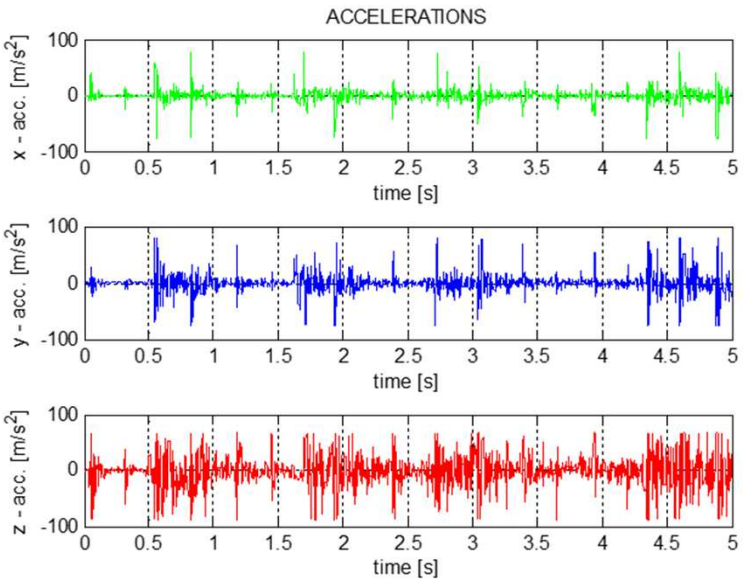
Tests location at RCCF Brasov; were used two accelerometers, in a S&C area

Fastening solution for sensor device: mechanical clamps as secondary solution

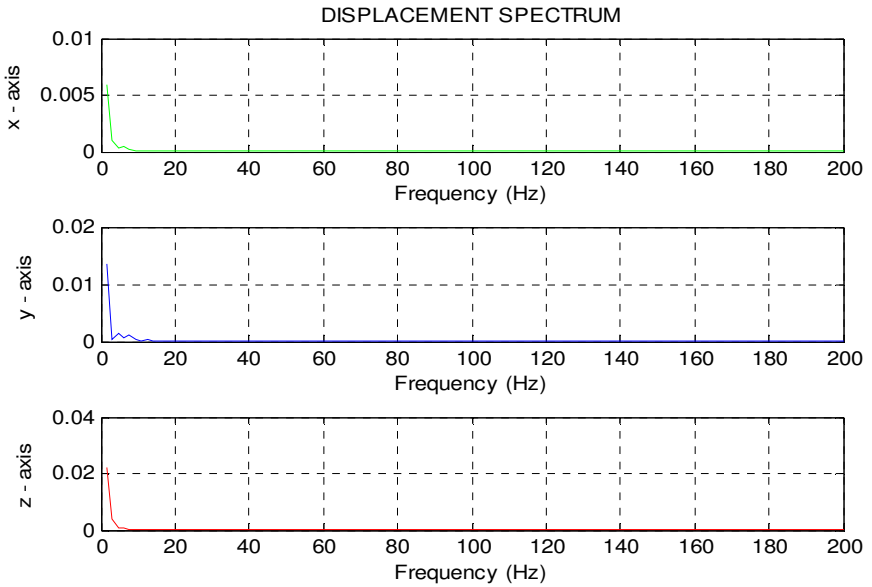
Experiment session at RCCF – Brasov (2)

Sequence of acceleration registration

Accel. in time domain



Displacement spectrum for three axis



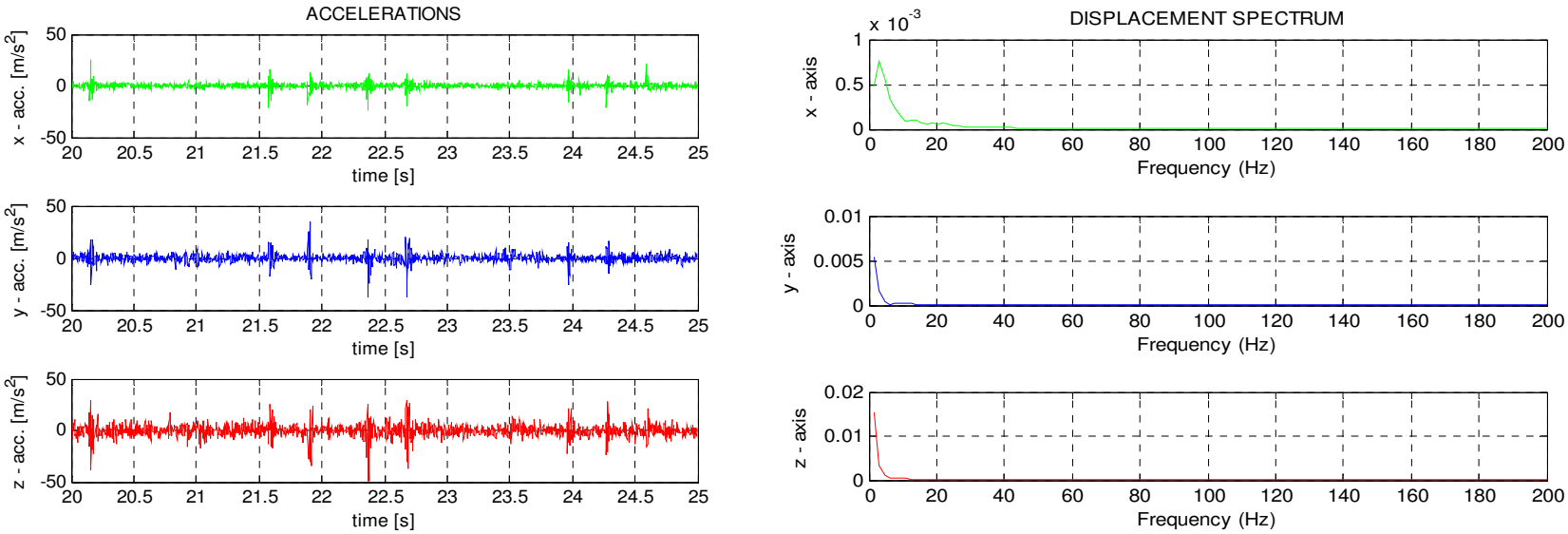
Experiment session at TCDD – Turkey (1)

- Double adhesive gluing solution, for fastening sensor device on the foot of the heavy type rail, is reliable after surface rail polished

- Heavy rails type: 60Kg/ml
- In the data collecting area the sleepers were by solid concrete
- Were monitored freight trains
- Speed: under 50 Km/h, like on RCCF compared test

Experiment session at TCDD – Turkey (2)

Accelerations amplitude and displacement spectrum for three axis



- Solid concrete sleepers; vibrations are lower than RCCF tracks
- Frequency existing components are bit higher than for wooden sleepers

Experiment session at AFER – Faurei (1)

- Were carry out complex measurements at several interest locations types and at many speeds: 30 km/h, 60 km/h, 90 km/h and 120 km/h
- Locations done measurements:
  - S&C, used as entry point on the ring
  - Insulating joint for track circuits
  - Continuous line section
- Entire length of the testing ring has only concrete railroad sleepers
- Will be presented tests and graphics for insulated joint location, when speed of 90km/h

Experiment session at AFER – Faurei (2)

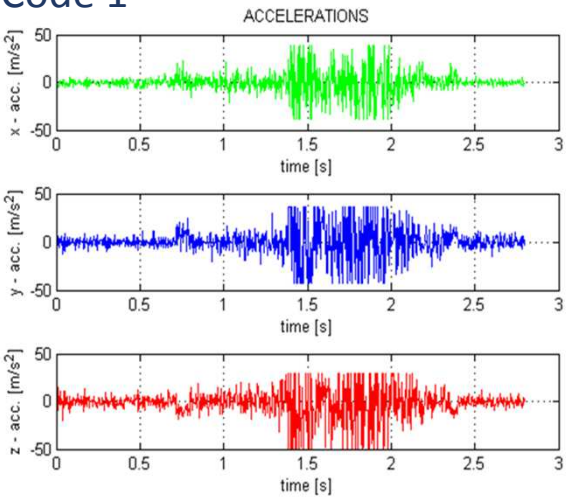
Locomotive used for tests

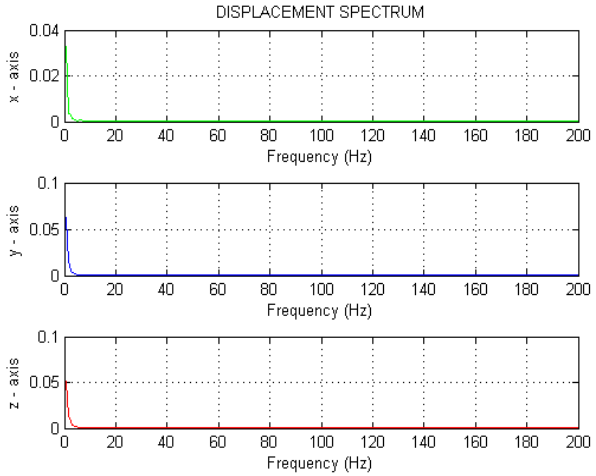
Mounting accelerometers

- It is a joint inside the curve.
- The two rails are at different levels
- Registration were made for speed of 90km/h
- Sensors fixed with mech. clamps
- Code 1 - on the inner (lower) rail
- Code 2 on the outer (higher) rail

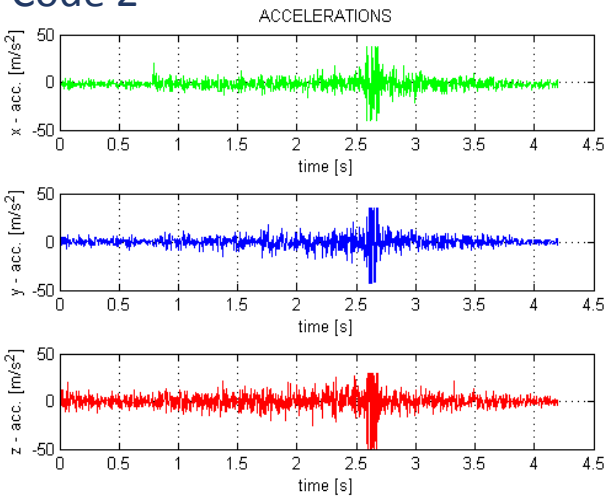
Experiment session at AFER – Faurei (3)

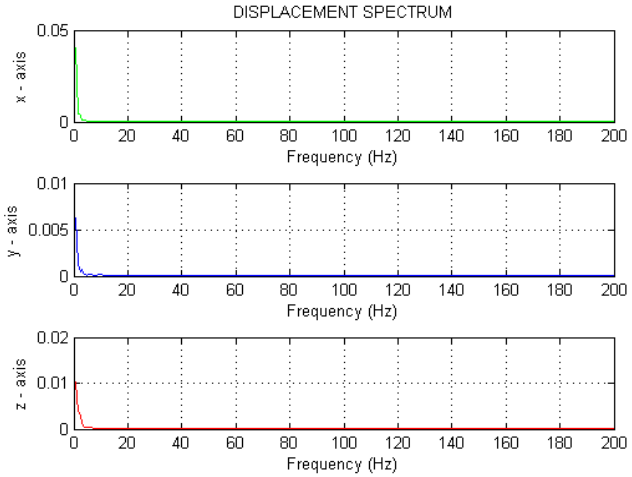
Code 1





Code 2

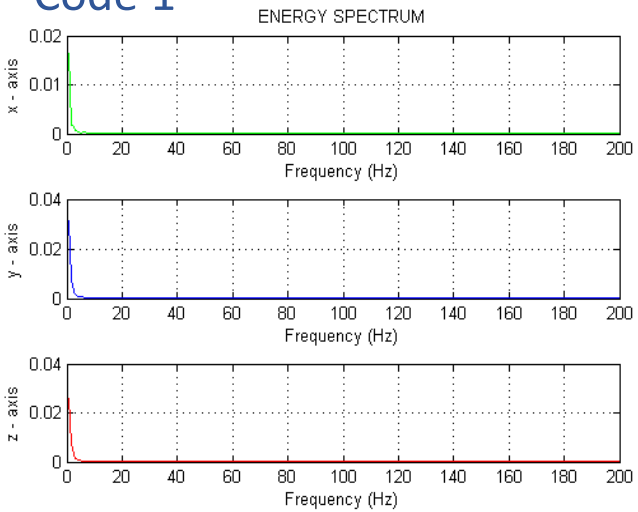




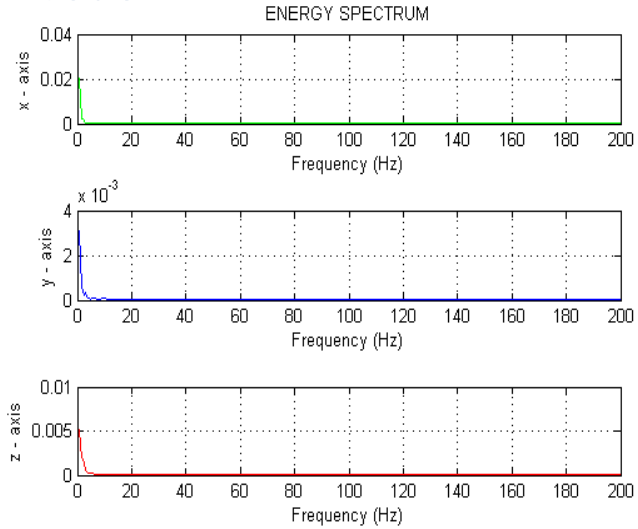
- Uneven pressing rail and transfer of uneven energy cause different wear degree
- The frequencies are in the expected range

Experiment session at AFER – Faurei (4)

Code 1



Code 2



Considerations about solution usability:

- Can help designing sections in the curve, as it can show behavior in real conditions
- Over time, the optimal speed for uniform displacement is changing, due to unequal degradation; system helps to find new optimal speed
- As conclusion, the system is useful for plain line, S&C but also for in curve sections monitoring
- Having similarities, could be linked with acceleration monitoring system, for overhead contact line

Thank you for your attention!