NeTIRail

Needs Tailored Interoperable Railway Infrastructure

Acceleration monitoring system, for the overhead contact line system

NeTIRail-INFRA final conference

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Analogic & Digital Systems

Description of the developed system (1)

Concerns about vibrations in the contact line section

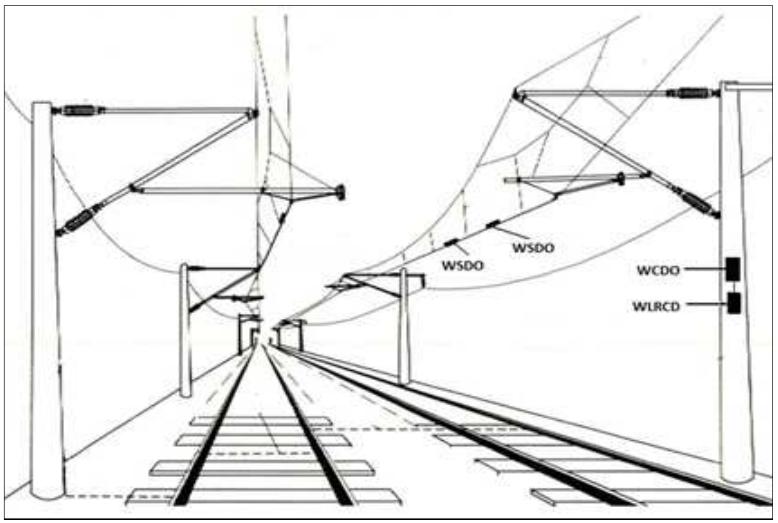
- Lower spectrum of the frequencies will cause decreasing of the contact line resilience. In this range, vibrations are easy propagated, with low attenuation, into the longitudinal section of the lines.
- Large amplitude of vibrations in the overhead contact line will lead to fatigue cracks in the section of wires and clamps, mostly where they are fastened.

Tests performed were accomplished at two levels

- Laboratory environment experiments: ADS lab. and at USFD specialised laboratory.
- Real field conditions experiments. Because of special conditions needed, only one session organised by AFER at Faurei test ring

Description of the developed system (2)

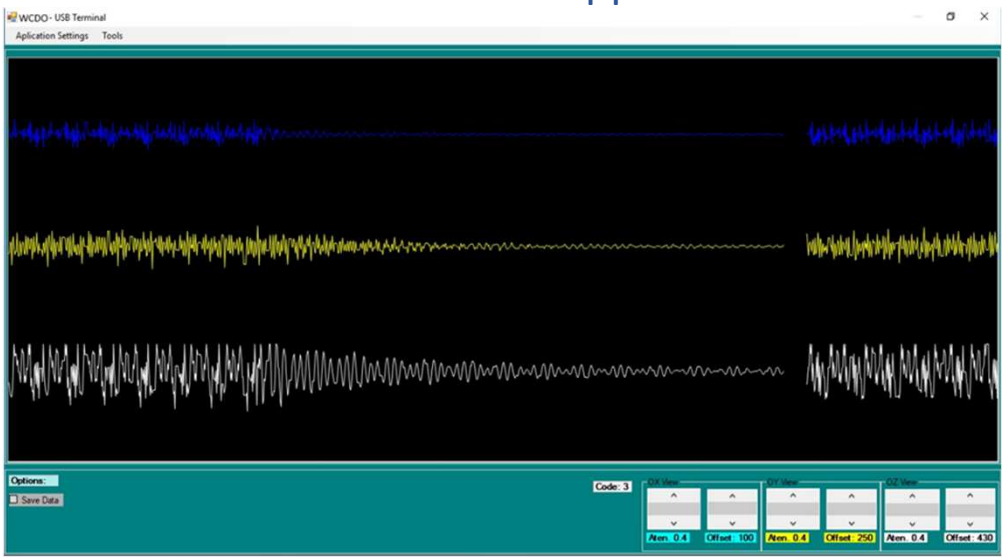
Design of the devices placement



Devices: WSDO, WCDO, WLRCD

- User interface (GUI) application will receive and will display the values in real time

Terminal interface application



- User interface will save data, one message on every row, in .csv format

Advantages of the using system (1)

- Main objective: to collect displacement data, for long time, from the contact point between pantograph and contact line
- Large amount of data, over long time, help analysing interaction pantograph and contact line, also provide info about wearing degree
- System solution is in the low cost category as important designing stage focus objective
- Help for changing periodic time planning maintenance strategy, to maintenance “on-demand” strategy
- Fast detection of critical defects
- Historical and comparative data will help in improvements for the future new OHL designs
- Useful for wearing degree monitoring also for other OHL components (droppers, catenary wires, isolators, etc.)

Advantages of the using system (2)

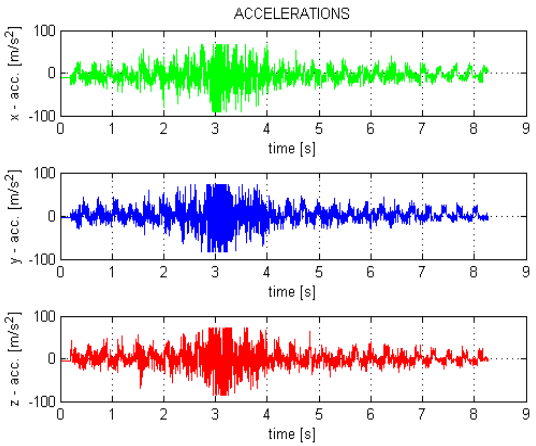
Novelty technical characteristics

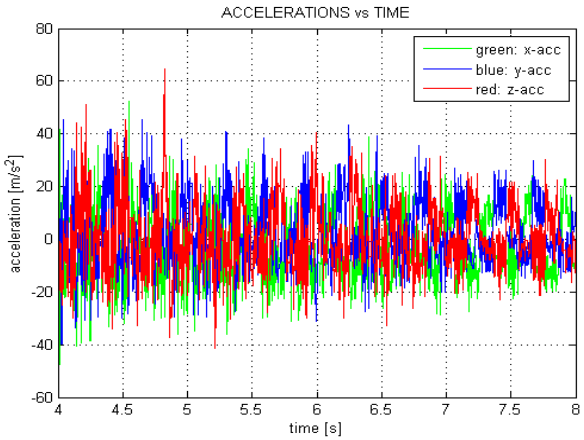
- Wireless communication: non invasive as no wires for data transmission
- Total autonomy as power supply; uses batteries and photovoltaic cells
- Only one accelerometer circuit used, for all three axes
- Harsh environment functioning

Tests Settings

- The firmware gets the acceleration values with 400 SPS, for all axes
- Default setting is +/- 4g, for the acceleration scale
- The sensor keeps collected data on 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

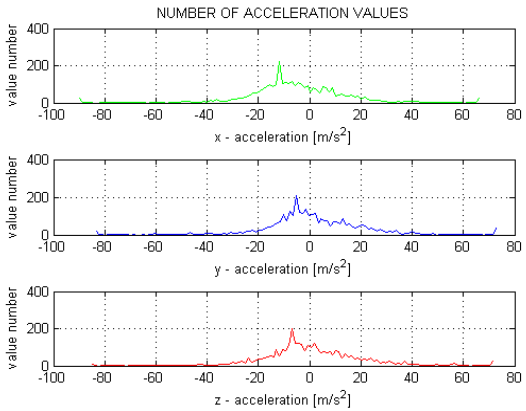
Post process functions (1)

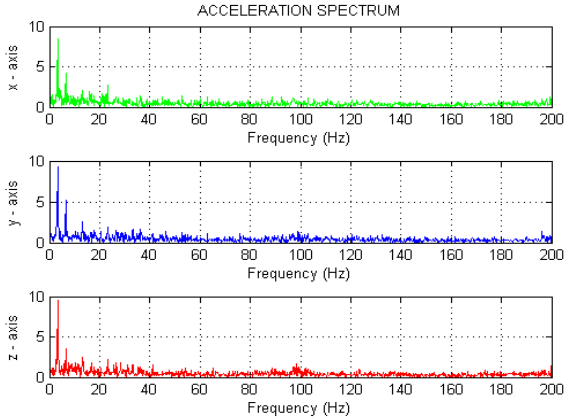


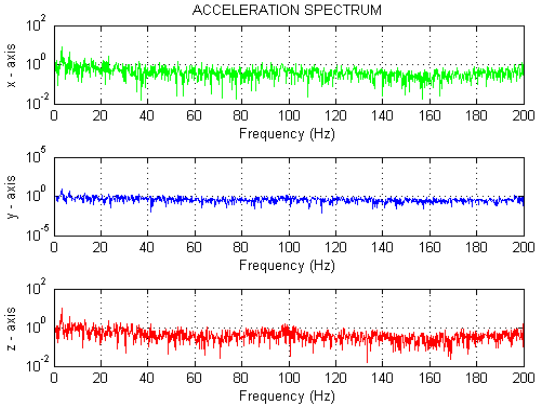


- Accelerations amplitudes in time domain
- Accelerations amplitudes for short time frame

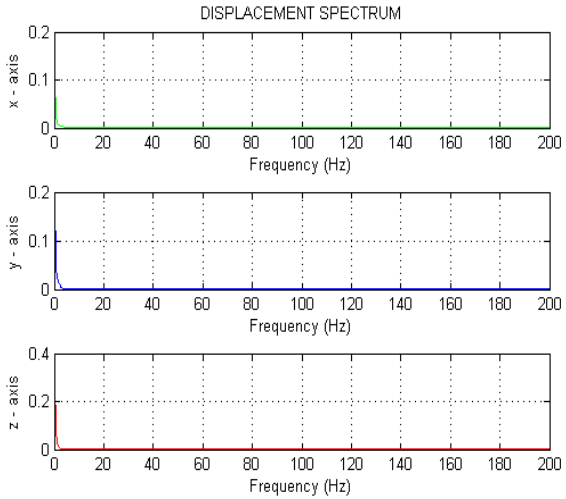
- Accelerations values distribution
- Acceleration spectrum, with linear and logarithm vertical scales

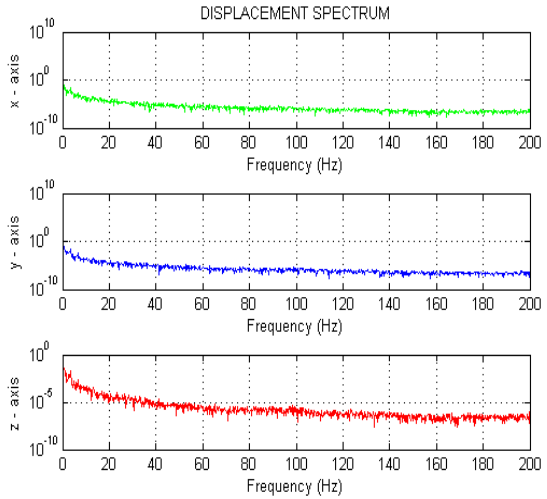




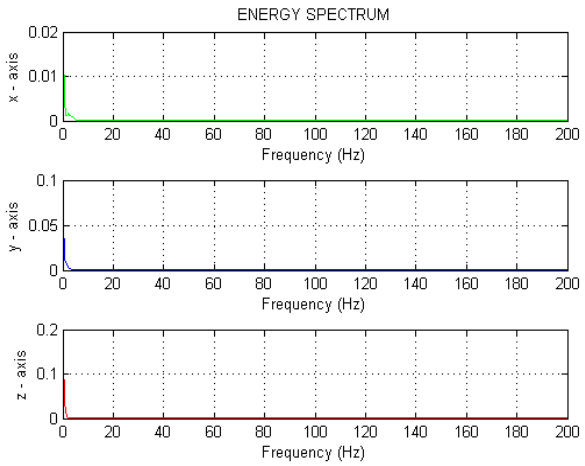


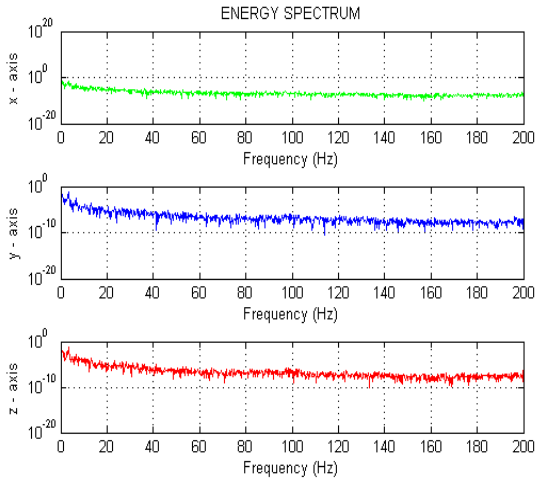
Post process functions (2)





- Displacement spectrum for the three axis with linear and logarithmic vertical scales





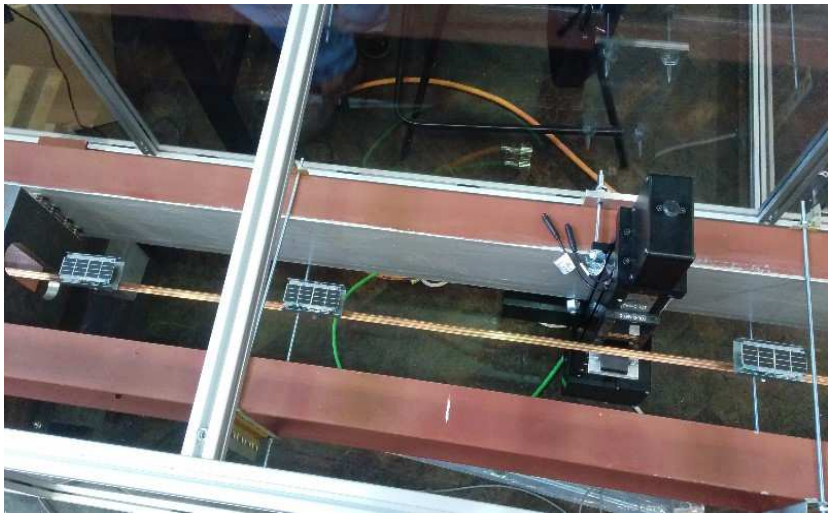
- Energy spectrum for the three axis, with linear and logarithmic vertical scales

Experiment session at USFD – Sheffield (1)

- Experiments were done in 25 and 26 January 2018
- USFD laboratory provided an installation, specialised for producing accelerated wearing of the contact line
- Sensors were mounted on several locations of the installation
- Were registered many types of displacements for the contact line: different frequencies and shapes
- Post process compares of what was generated by the actuator with data received by sensors

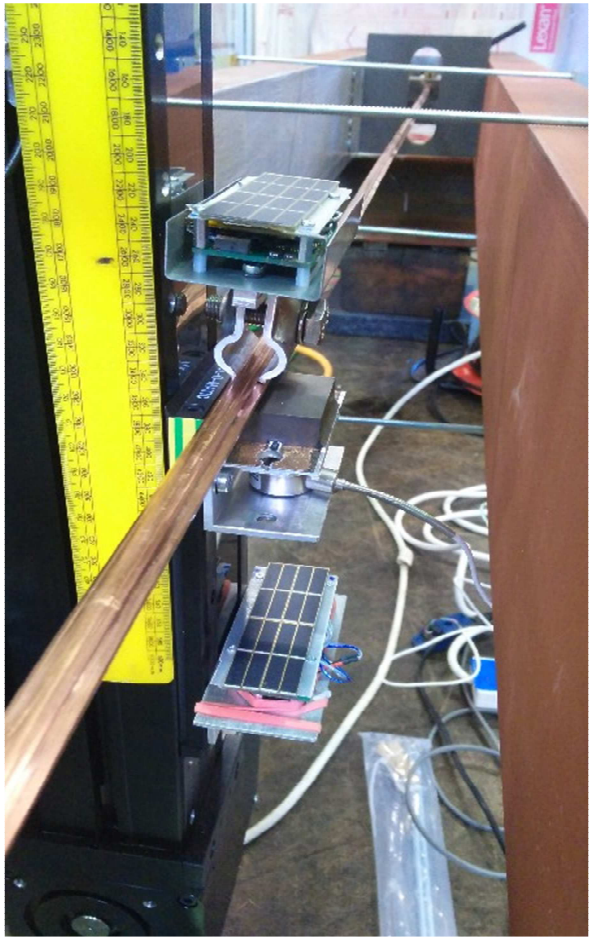
Experiment session at USFD – Sheffield (2)

Three accelerometer sensors placed on the contact line



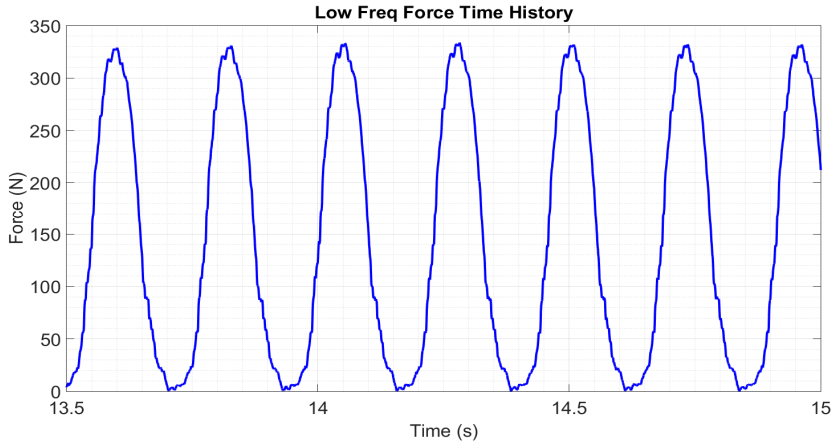
- High and low freq. pulses, singular pulse, etc., were generated from the actuator application.

Sensors placed on the contact line but also on the actuator body



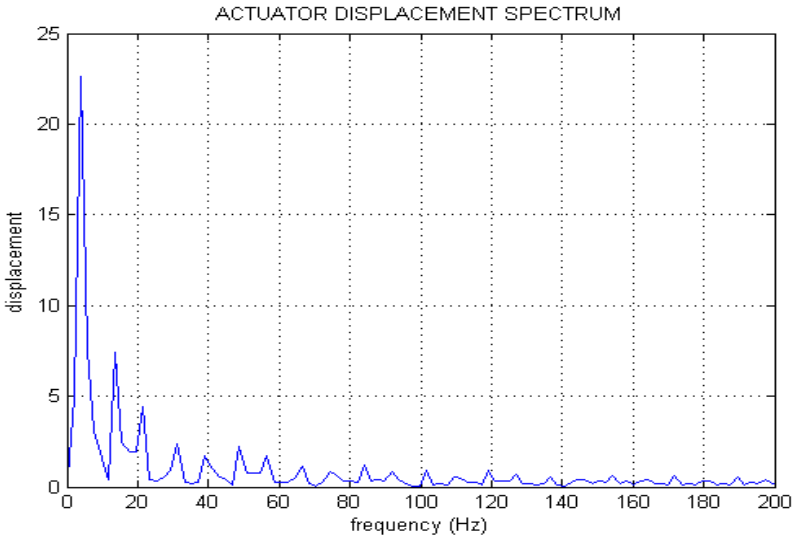
Experiment session at USFD – Sheffield (3)

Low frequency actuator force applied for one axis



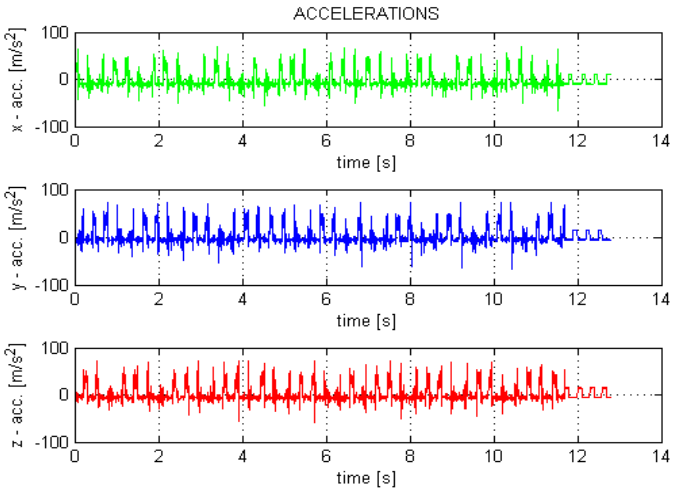
- Vibrations of the contact line have been variated, by modifying the contact force simulated by the actuator
- In same time, acceleration of the contact line collected with the developed sensors
- Post processing functions represented

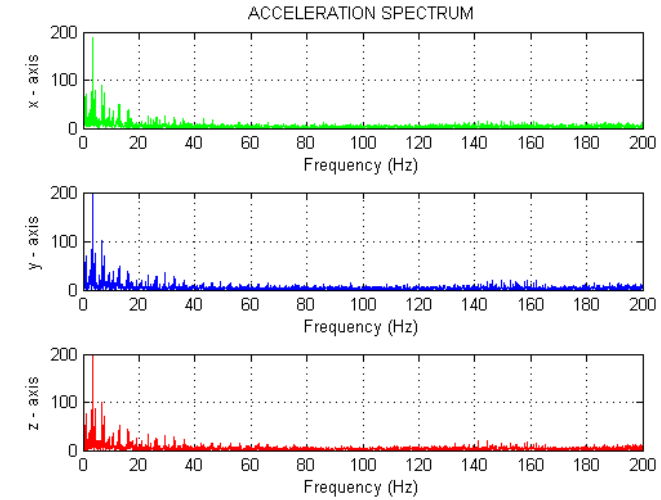
Displacement spectrum from actuator generating



Experiment session at USFD – Sheffield (4)

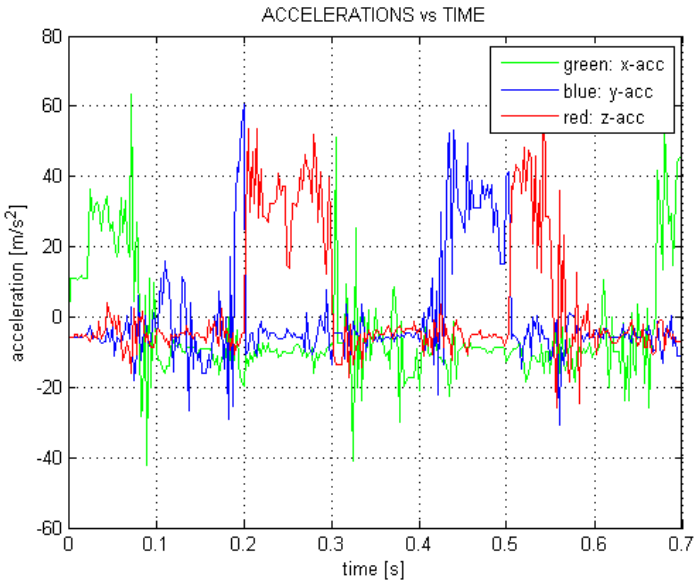
Accelerations amplitude received from the contact line





- Even the actuator provides displacement on the 0Z axis, the energy and displacements are spread on all three axes

Details with narrow time frame



Experiment session at USFD – Sheffield (5)

Conclusions:

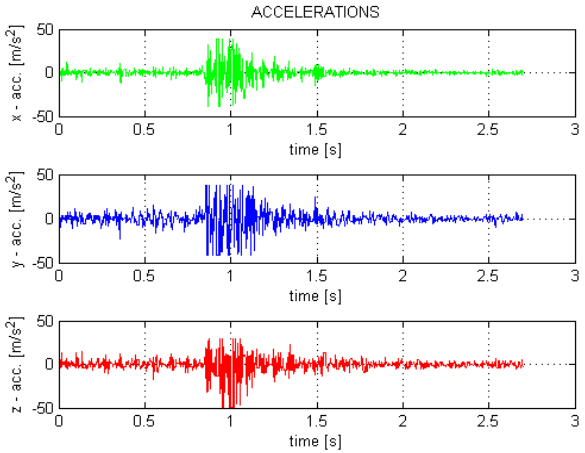
- The actuator application simulates contact force and displacement on one axis: OZ, but effects are spread on all axes
- The system developed could help to see the effects of the actuator programs on all axes
- Further, data collections, from real field, could provide patterns to create actuator programs, closer to real behaviour of the contact force

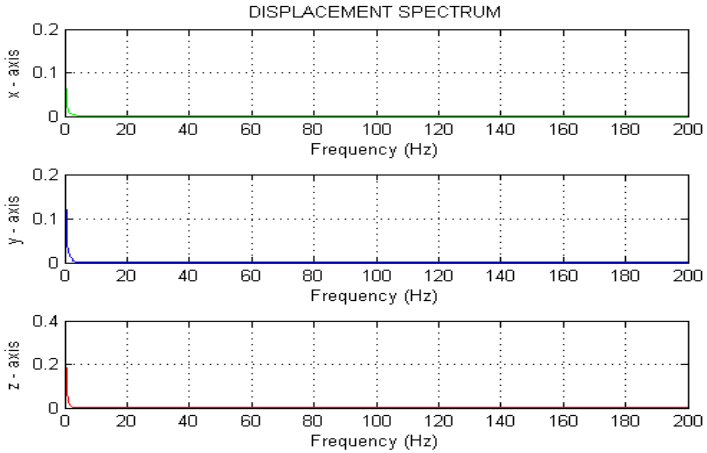
Experiment session at AFER – Faurei (1)

- Only one session in field conditions, because of organizational difficulties
- Two sensors mounted

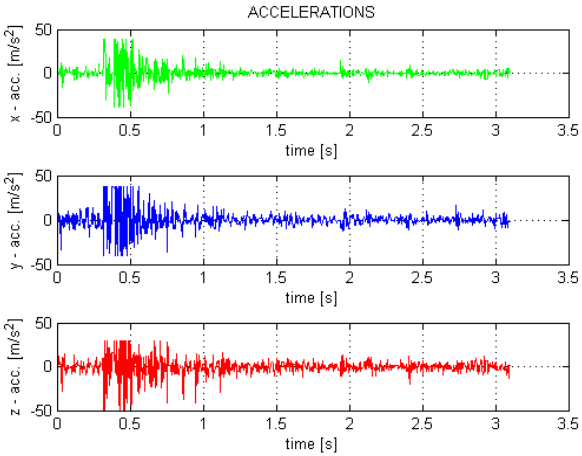
Experiment session at AFER – Faurei (2)

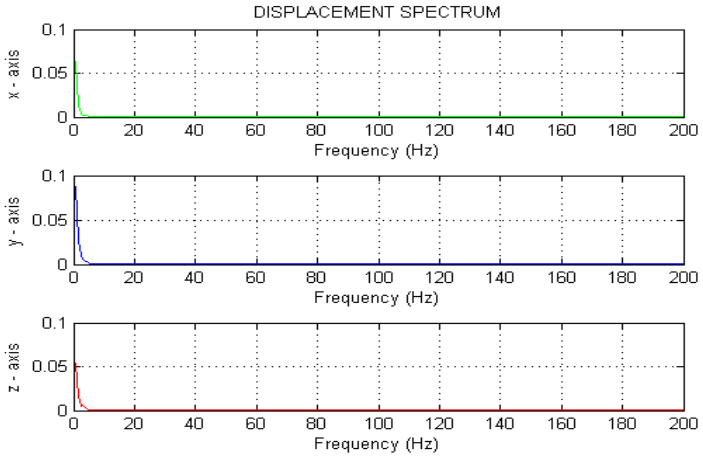
Code 2





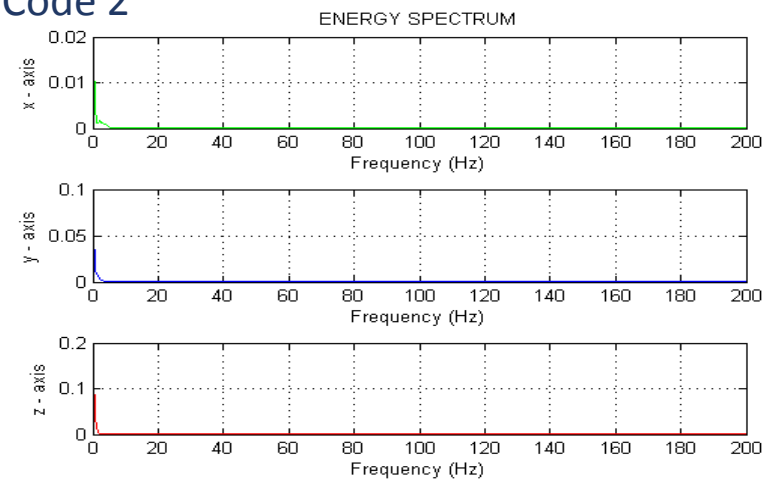
Code 1



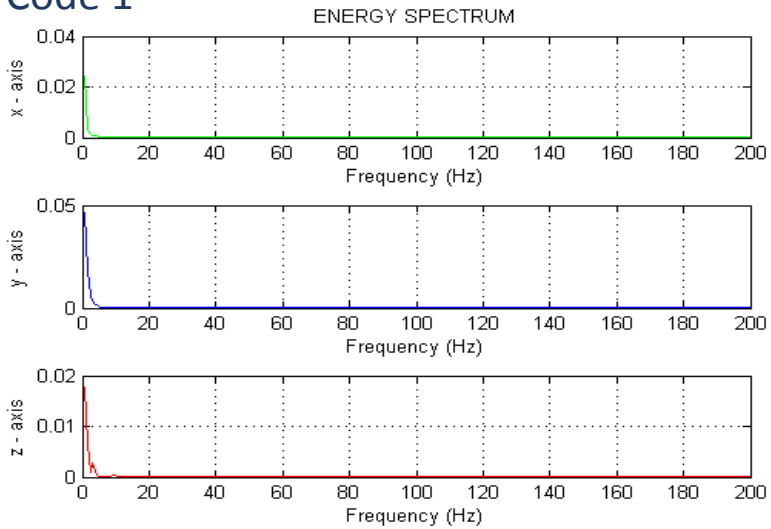


Experiment session at AFER – Faurei (3)

Code 2



Code 1



Conclusions:

- Related with other systems developed, this was considered most concerning for not functioning
- These experiments were most spectacular and most dangerous from all tests
- Having similarities, could be linked with acceleration monitoring system, for track lines
- Main benefit is the opening a window for applying microelectronics in the very high voltage area of railway infrastructure
- Real field tests were done with the prove of success

Experiment session at AFER – Faurei (4)

Thank you for your attention!