



Needs Tailored Interoperable Railway Infrastructure

Application for comfort monitoring, using low cost Smartphone

NeTIRail-INFRA final conference

Ljubljana, 24 May 2018

Lucian Emanuel ANGHEL



Content



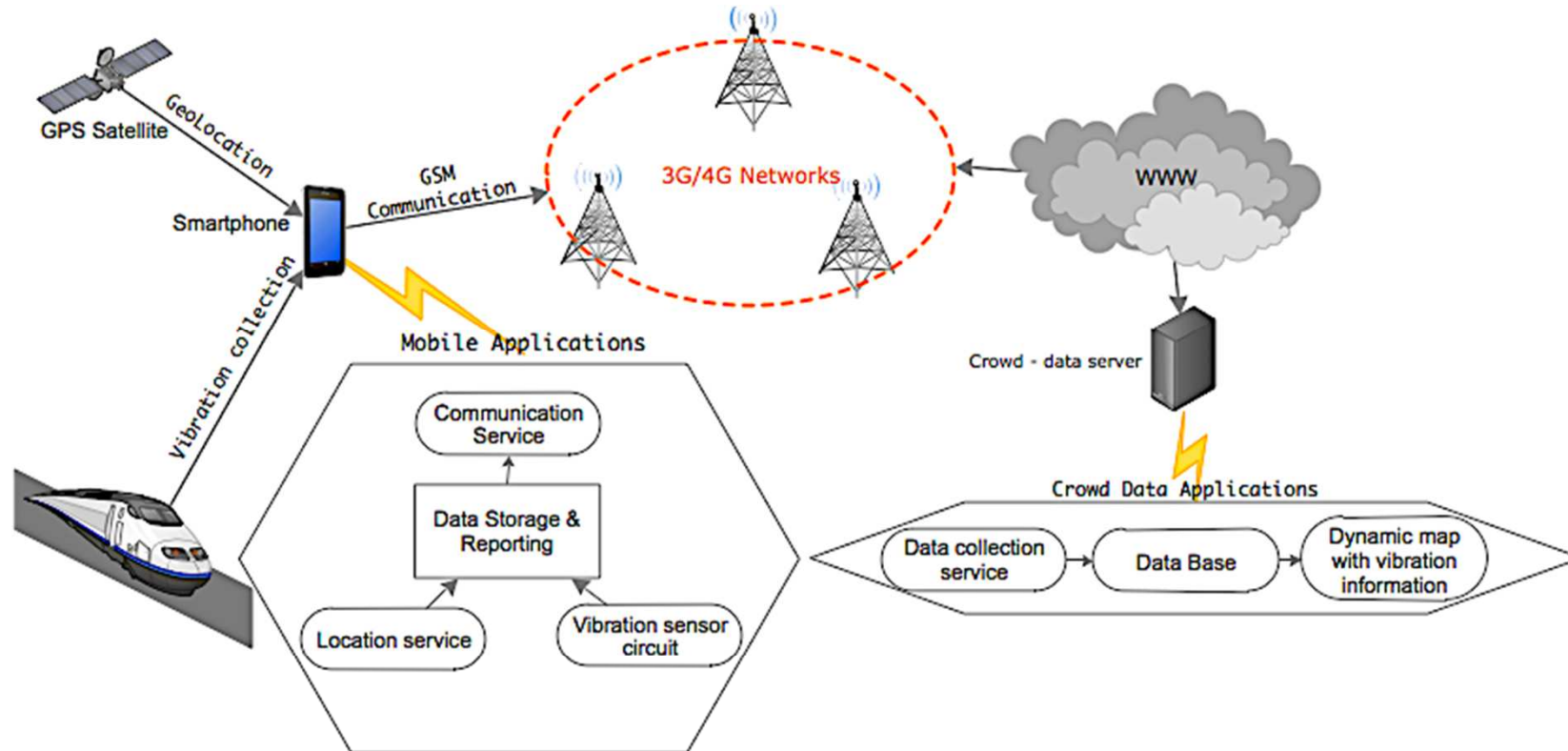
- Main goals
- System Architecture
- Standards & Models for evaluation of ride comfort
- Layout & Functionalities of smartphone application
- Test result on Test Line “Bartolomeu – Zărnești”
- Conclusion
- Questions



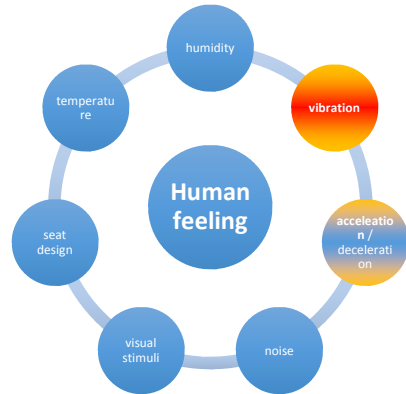
Main goals

- The general goal of Task 4.3 is the development of a smartphone based technology for vehicle, infrastructure and comfort passenger monitoring, i.e. crowd-sourced data collection, to increase the regularity and granularity of the monitoring data available.
- Expected results of this task are:
 - Developing an app to gather data from the smartphone GPS sensor and its accelerometer. This will consider conservation of battery life as a priority to ensure viability of the app.
 - Developing a gateway to which the data is transmitted using the phone 3G or WiFi connection.
 - Developing an interface for querying of available data (e.g. relational database structure).

System Architecture

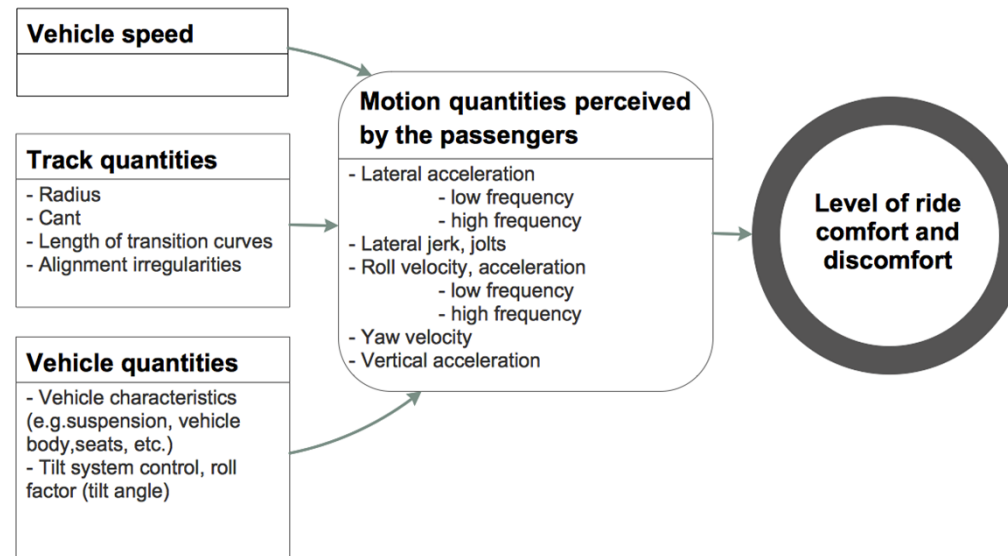


Standards & Models for evaluation of ride comfort



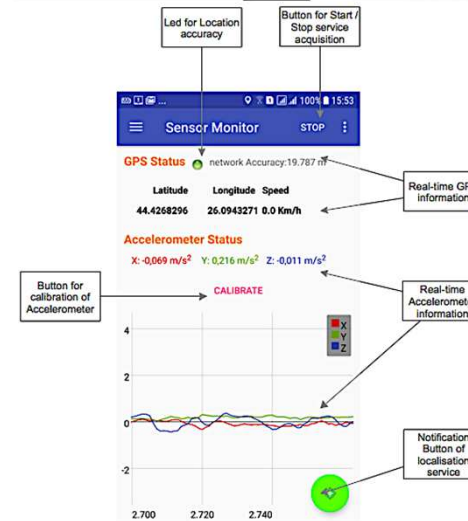
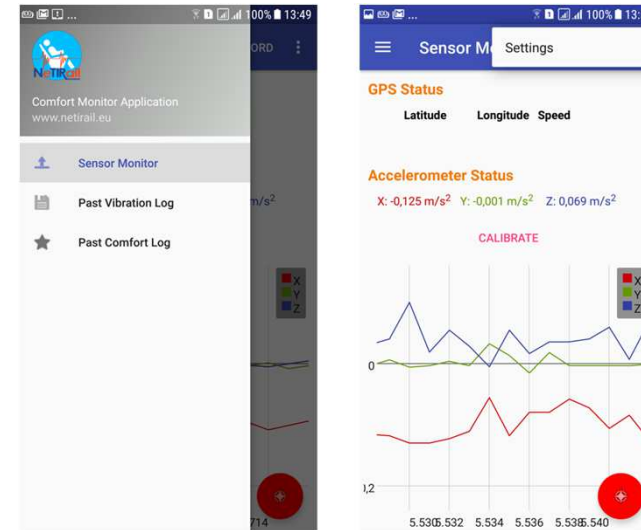
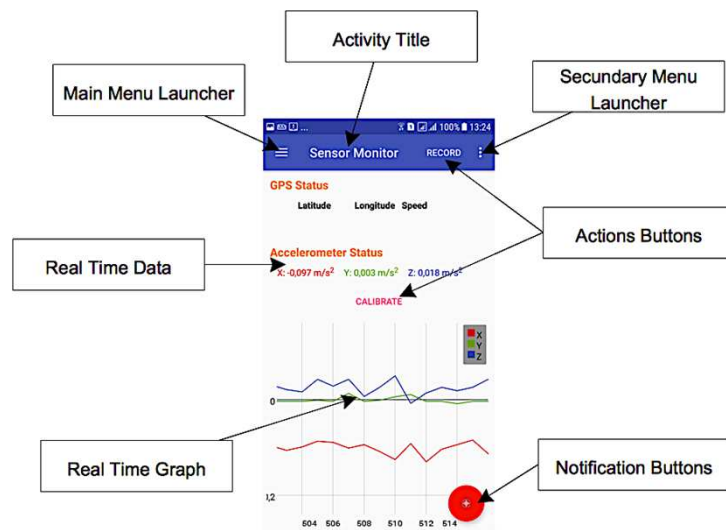
Perception of ride comfort - ISO-2631-1:1997

r.m.s vibration level	Preceptions
Less than 0,315 m/s ²	Not uncomfortable
0,315 m/s ² to 0,63 m/s ²	A little uncomfortable
0,63 m/s ² to 1 m/s ²	Fairly uncomfortable
1 m/s ² to 1,6 m/s ²	Uncomfortable
1,6 m/s ² to 2,5 m/s ²	Very uncomfortable
Greater than 2 m/s ²	Extremely uncomfortable

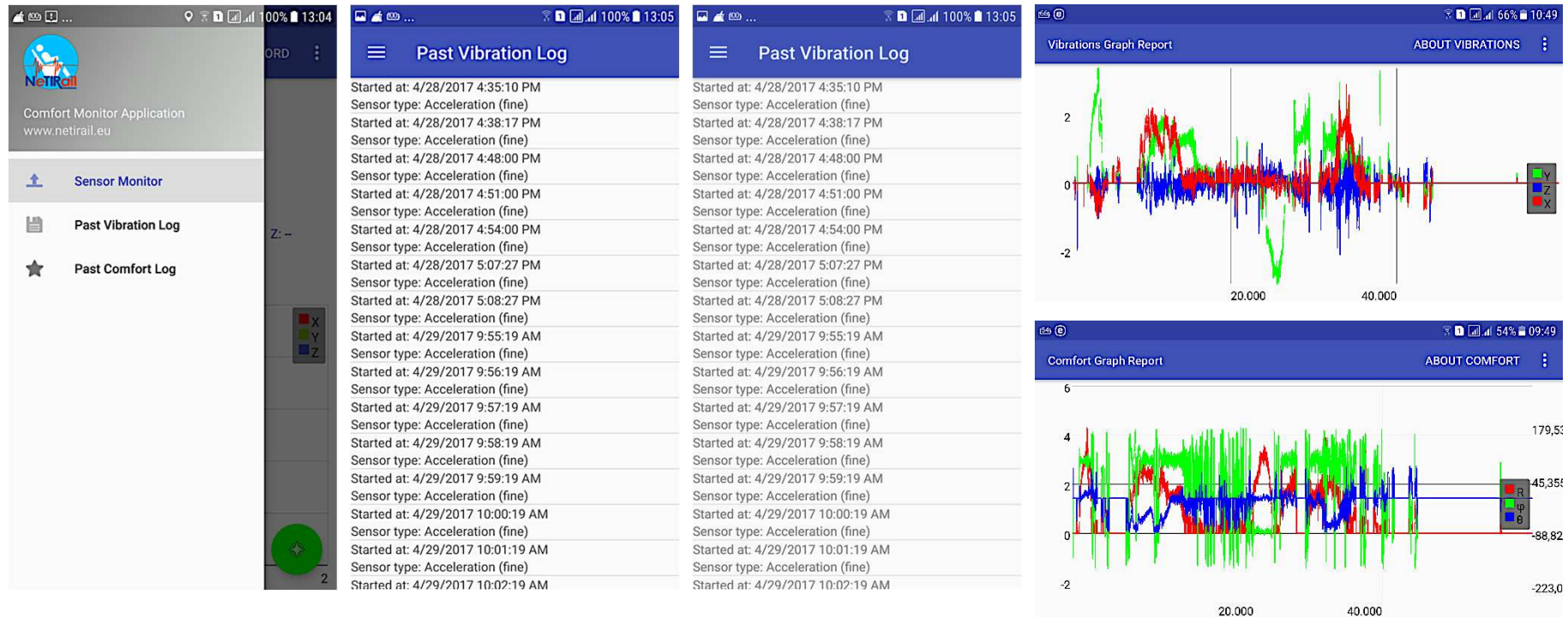




Layout & Functionalities of smartphone application



Layout & Functionalities of smartphone application (2)



Navigation logs & graphical display of logs



Test result on Test Line “Bartolomeu – Zărnești”

- On 19.07.2017 or purchased data on the round trip Bartolomeu – Zărnești with a passenger Diesel Multiple Units type XBD 4520

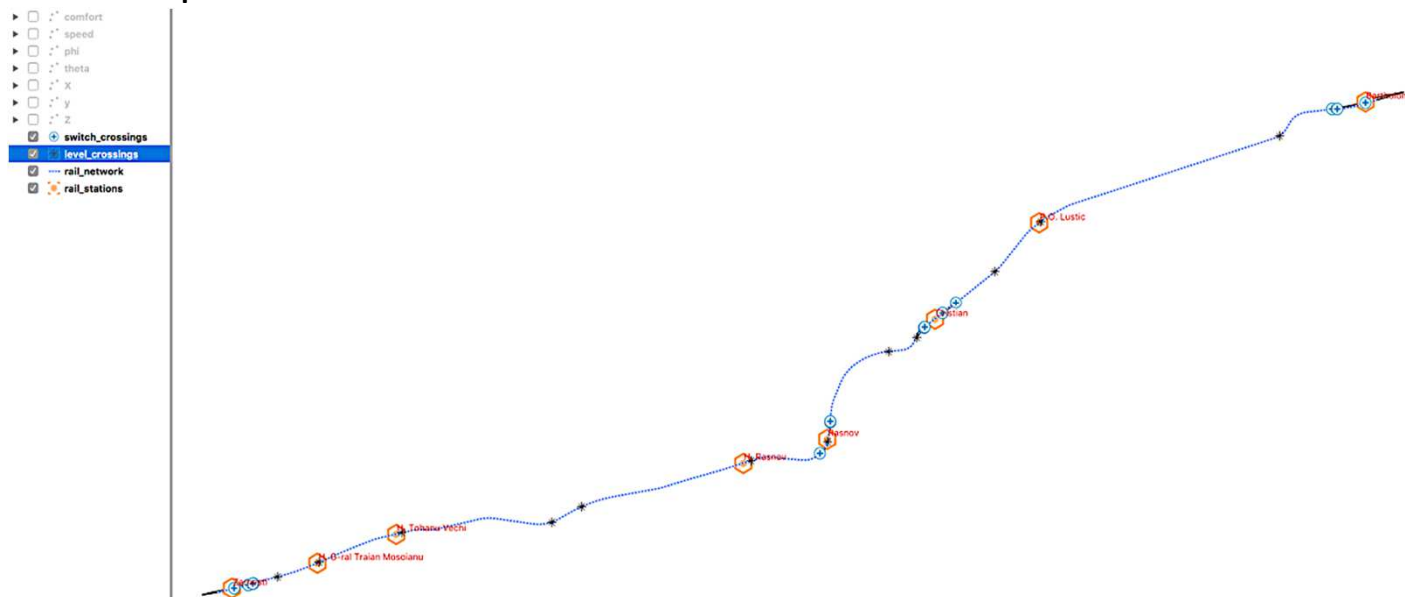


Initial configuration and preparing the track and ride quality monitoring tests



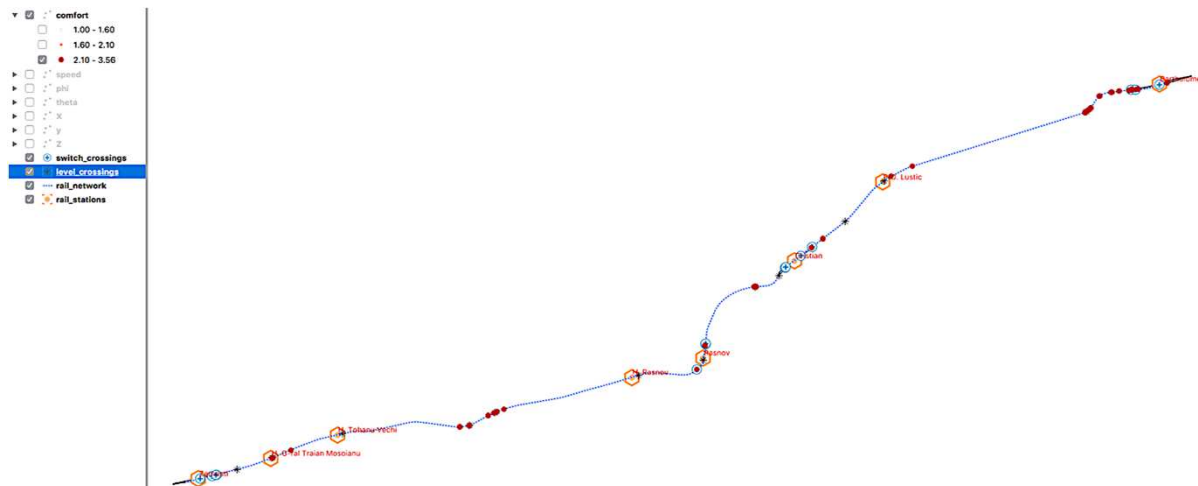
To perform the test in the database, the following categories of geographic information were collected:

- Track line
- Contour and station position
- Contour and level crossing position
- S&C position



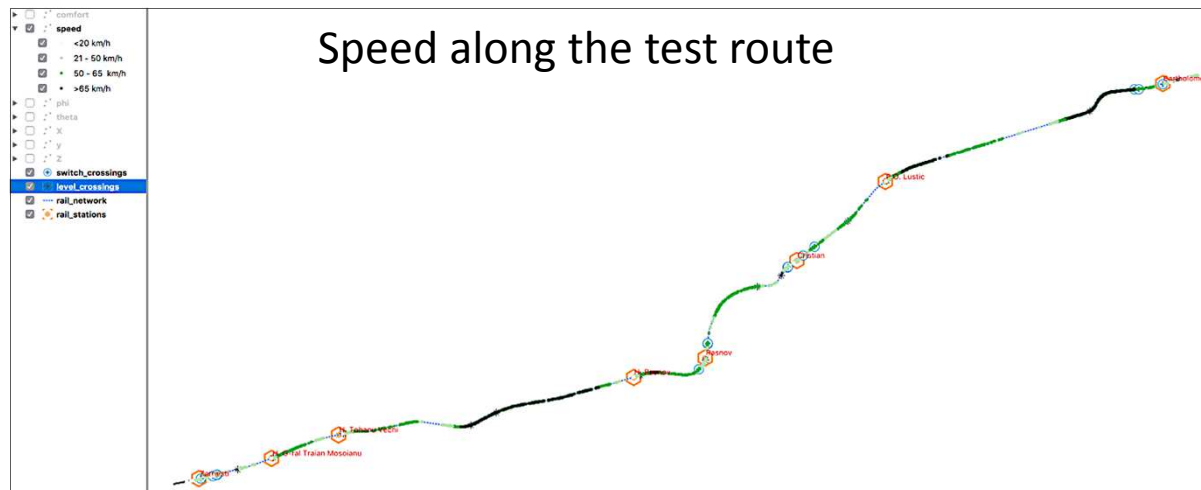
Detection and validation

- After performing the measurement, over the full track Bartolomeu-Zărnești, the potential defect detection algorithm was run as off-line. Based on smartphone application, the location of the places where the accelerometer signals show largest energy variations were highlighted as presented in the next figure



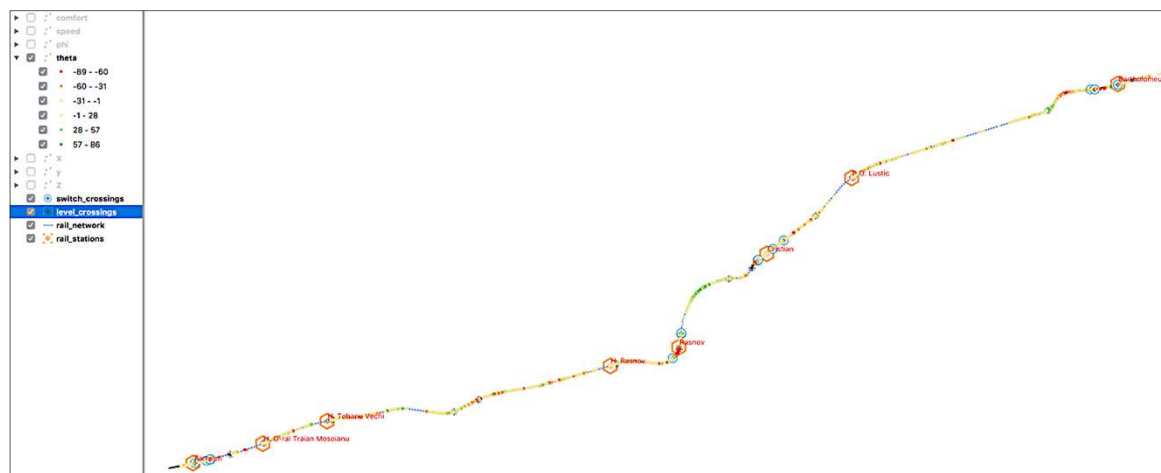
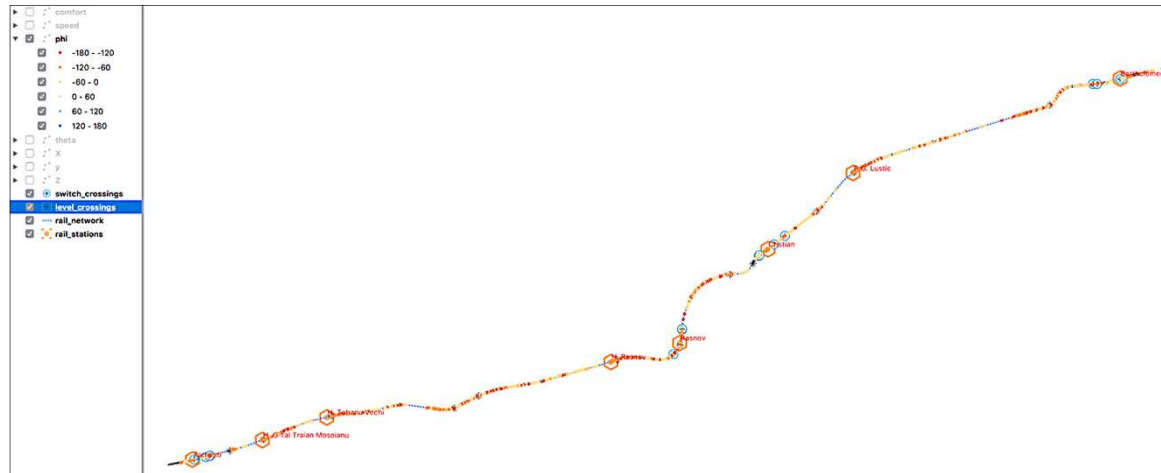
Detection and validation

- Next, are presented few examples of smartphone application signals, for different categories of information collected.



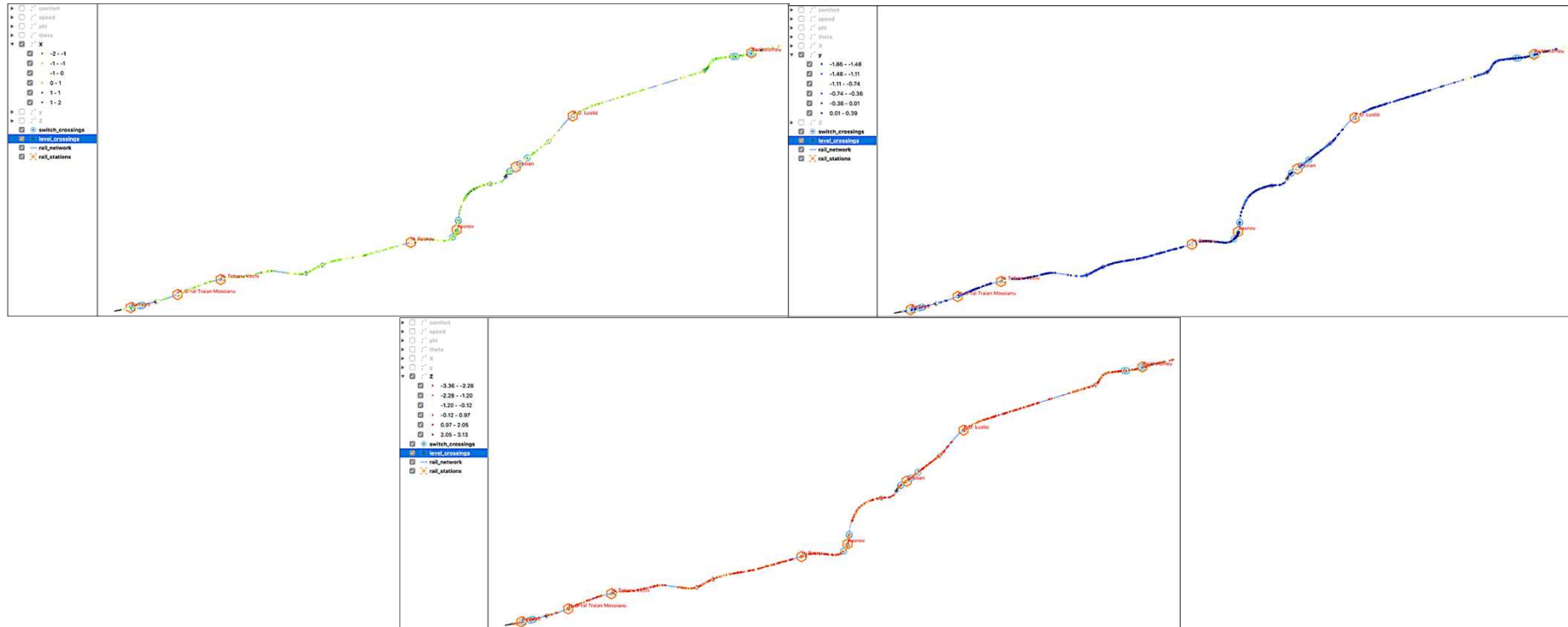
Detection and validation

- Roll (a) and Pitch (b)



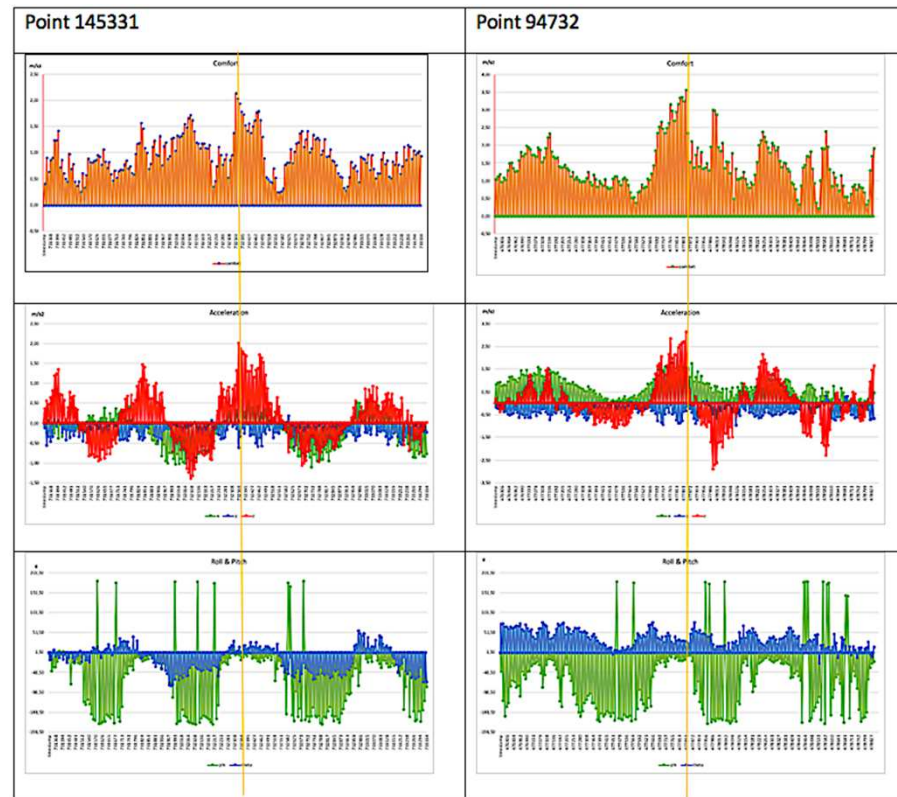
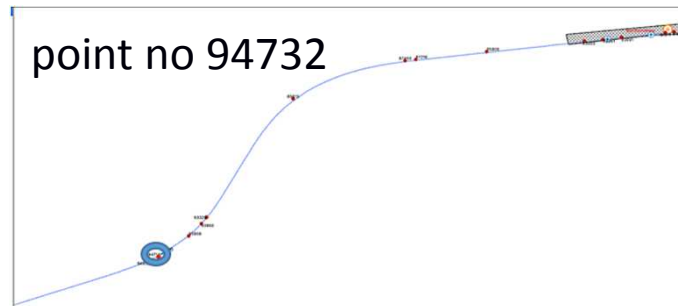
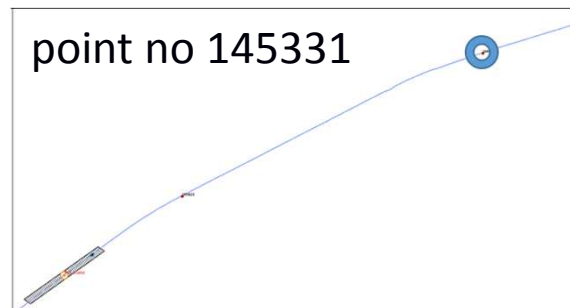
Detection and validation

- Accelerations along x, y, z axis



Detection and validation

- To depict the detection results, we select two samples, whose location is out of disturbing effects as level crossing, S&C or the surface of the stations, of which one with the highest vibration





Conclusion

- We also estimate that by using the developed systems the following benefits can be achieved:
- **Estimate of cost savings** in maintenance and renewals resulting from the application of the new smart-phones solution:
 - By analysing the vibrations in time, coupled with the speed of travel at the level of a rail unit, the possible defects of the suspension system can be identified more quickly than in the case of regular visual inspections.
 - By analysing the comparisons of rolling speed records, fuel consumption can be reduced by adjusting the driving mode without affecting the time schedule
 - By analysing roll velocity data, coupled with Location provided by GPS, can identify failures in the track geometry, aspect that cannot be done through periodic visual maintenance
- **Benefits**
- Increasing attractiveness of train use by improving passenger comfort
- Track monitoring. The innovation may increase the availability of status of track sections, because it eliminates the need to inspect, time to set and check the route. This is relevant to include in the assessment if capacity is fully used during parts of the day.

Questions

NeTIRail



Thank you for your attention !