Università della Calabria

Dipartimento di Matematica e Informatica

Corso di Laurea in Informatica

Monitoring road surface conditions using IMU

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Summary: *This work focuses on the development of a system for the monitoring of road surface conditions, that makes use of inertial measurement units (IMU), electronic hardware systems based on inertial sensors, such as the ones in our smartphones. The system is based on the reading of data collected, and on the post-processing elaborations of the GPS signal and acceleration data, (in which particular attention is given to high-energy peaks). Three indexes of the road quality are extrapolated.*

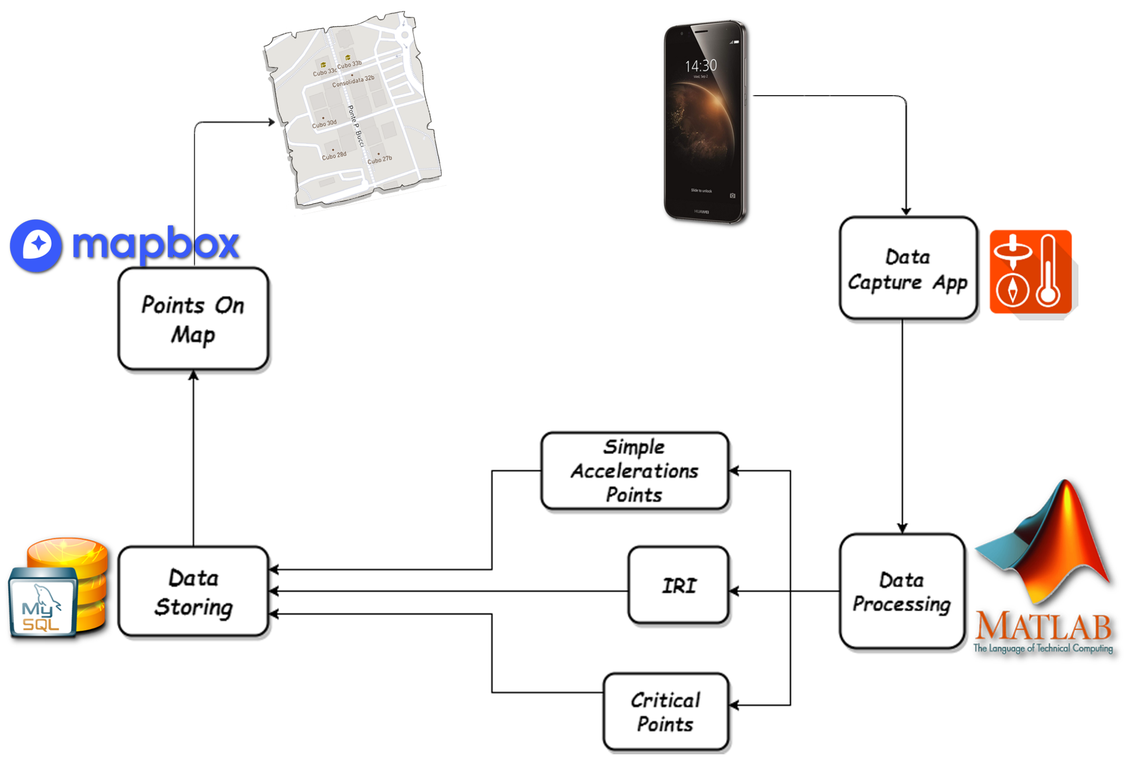
Motivation

- Providing the correct location of the most damaged points and assessing the overall of road quality makes the transport system more efficient, comfortable, and safer, disadvantages roads increase both the risk of car damages and fuel consumption.

- The detection of anomalies, such as potholes, small covering defect, breaks, and their proper location, has a significant impact on road infrastructure maintenance, allowing public institutions to intervene properly.

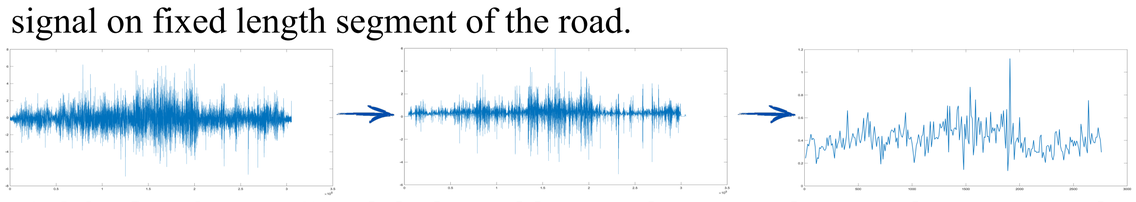
- The traditional instruments for road quality assessment are the profilometers. They directly measure the quality but are expensive and only trained people can use them. In this work low-cost inertial measurement systems are adopted, such as mobile devices sensors. They are able to get good road quality information and from countless sources (the general public).

System Structure

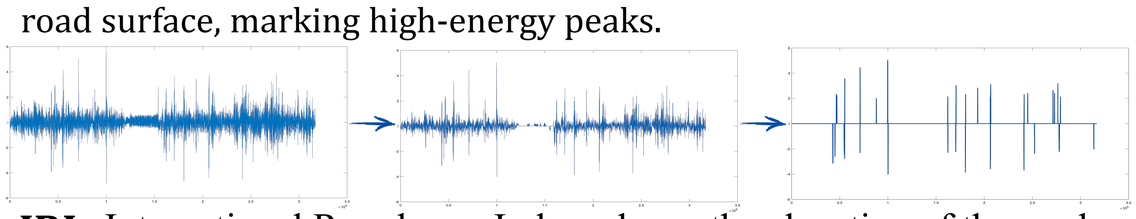


Road Quality Indexes

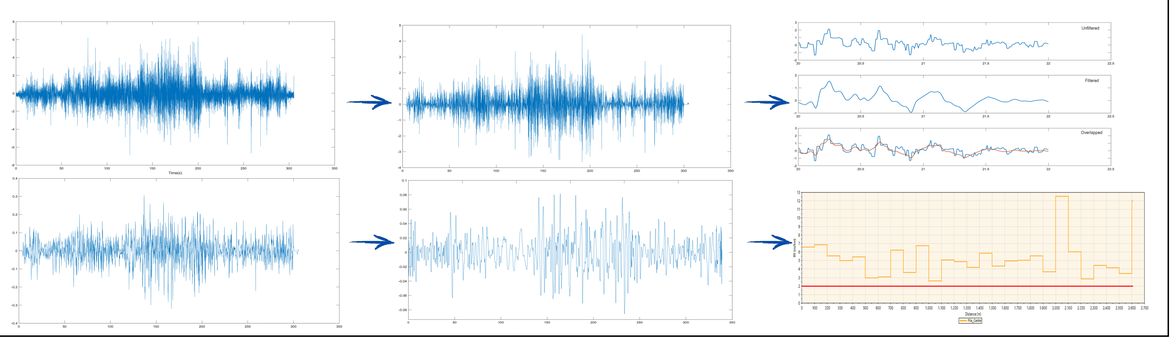
- **Simple Accelerations Points: (SPA)** shows the variation of the acceleration signal on fixed length segment of the road.



- **Critical Points: (CP)** labels and locate the most damaged points on the road surface, marking high-energy peaks.

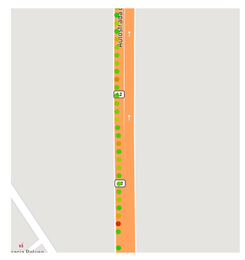


- **IRI:** International Roughness Index; shows the elevation of the road, applying the quarter-car mathematical model of a standard vehicle, travelling at 80 km/h.

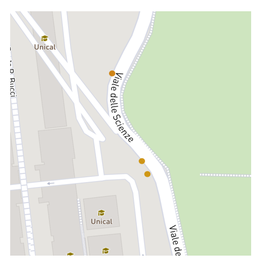


Results

- **SPA**: although he gives an idea of the profile of the road, result obtains using SPA index are not satisfactory because only uses raw acceleration data.

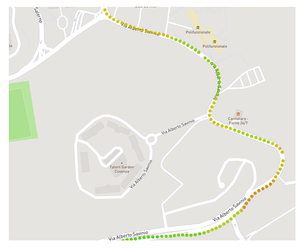


- **CP**: it correctly identifies high-energy peaks that correspond to the most critical road asperities, a precision of the methodology has been identified by visual inspection.



- **IRI**: the system is able to approximate the IRI.

- The system is able to collect data from multiple mobile devices and merge and store them into a database.



Conclusions

A road monitoring system that process acceleration/GPS, has been developed. The system it correctly identifies critical road segments and is able to compute a good approximation of IRI only use a cheap-sensors.