- MIRANDA DEMONSTRATOR -

AN AUTOMATED ROAD PROFILE MONITORING SYSTEM BASED ON THE USE OF PROBE VEHICLES AND SMARTPHONES

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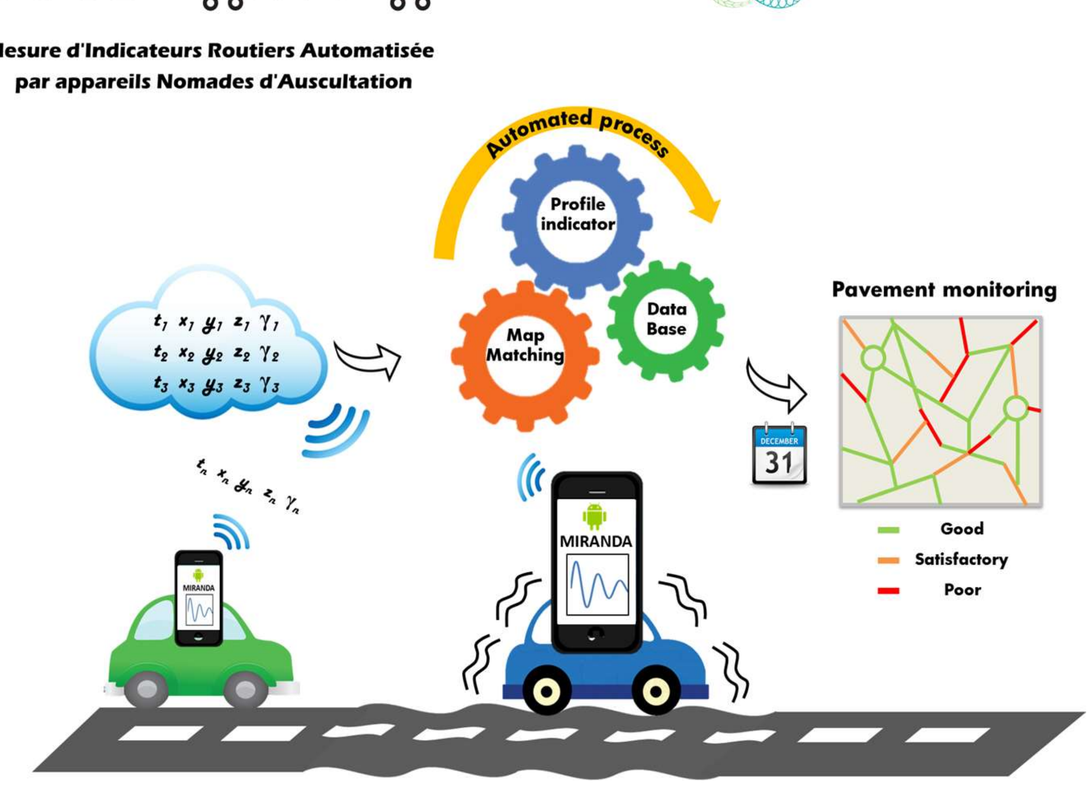
Mesure d'Indicateurs Routiers Automatisée par appareils Nomades d'Auscultation



GENERAL INFORMATION / GOALS

- A first level tool for the monitoring of the road profile on a network
- Detection and caracterisation of the road irregularities with $\lambda \in [3m ; 45m]$
  - This kind of irregularities are in relation with the level of comfort of users and may alert about a road structural problem -
- Automated data processing (from the raw data to the road indicator)
- System adapted to the monitoring of secondary roads

STRENGTH OF THE SYSTEM

- Information density : data collected « everywhere and anytime» by a fleet of probe vehicles
- Real-time monitoring : data are transmitted to a computer server using a wireless connection (mobile phone network or Wi-Fi)
- Low-cost solution (by comparison with the use of a specialized vehicle)

OBSTACLES / SCIENTIFIC CHALLENGE

- Level of accuracy of the data (low-cost sensors)
- Deal with the measurement uncertainties
- Provide a reliable system

WORKING PRINCIPLE

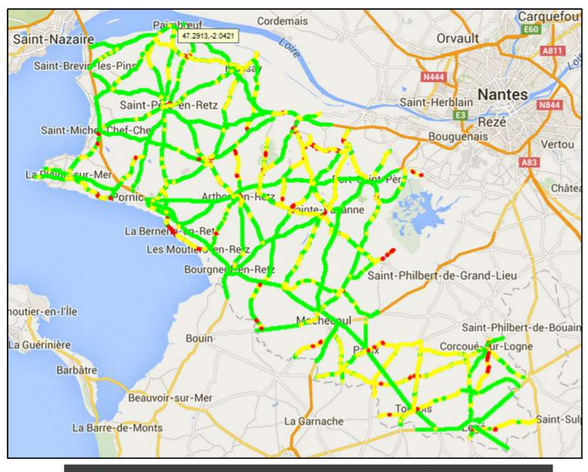
- The smartphones are used as measurement systems
- The sensors included in smartphones provide raw data (time, acceleration, GPS coordinates, etc.)
- The MIRANDA Application (Androïd) manages the measurement session (configuration, activation/deactivation of the survey, generation of the measurement files, etc.)

- The smartphone is embedded into a probe vehicle and data are collected during the ride

- The data are sent to a computer server and are then automatically processed in order to calculate an estimated road profile and the associated indicator
- The final information is entered into a database and could be visualized by the road manager with a GIS software

EXPERIMENTAL RESULTS

- Tests performed in real condition on a French network
- Monitoring of a 1000 km long road network
- Data collected during 2 months with a dozen of probe vehicles



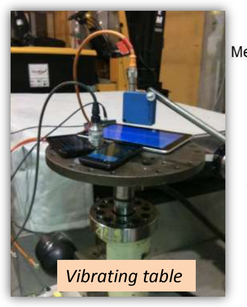
OUTLOOK

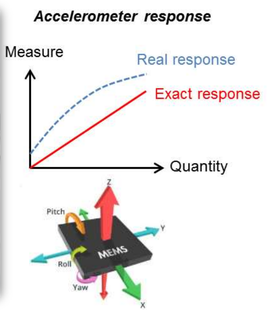
- Large-scale deployment of probe vehicles and validation
- Increasing the level of instrumentation of the probe vehicles (wireless communication between a smartphone and other embedded sensors)
- Estimation of other road indicators by using the same methodology
- Preparation of the marketing activity

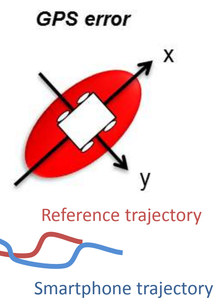
SCIENTIFIC and TECHNICAL WORKS

- Estimation of the level of accuracy of the sensors for different smartphones and tablets

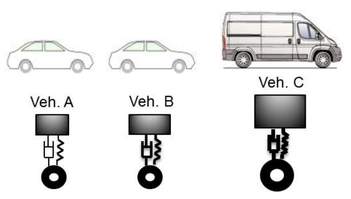
Tests performed in laboratory and in real condition

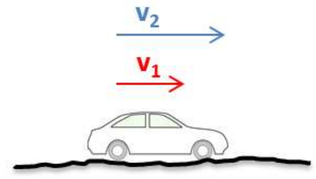




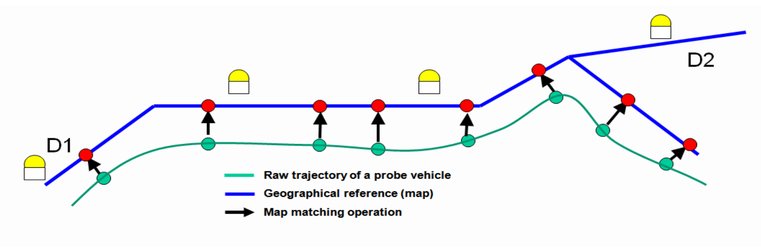


- Estimation of the measurement uncertainties caused by the use of a fleet of different probe vehicles





- Development of an adapted map-matching method for the projection of all the trajectories of the probe vehicles on a same geographic reference (automatization of the process, management of the cases with road singularities, consideration of the road location markers, etc.)



- Development of a data fusion algorithm for combinating all the data provided by the probe vehicles and taking into account the measurement uncertainties

- Development of an Android Application for data collection (MIRANDA App) and a specific software which runs the successive data processing operations (map-matching, data fusion, road profile calculation, exporting information toward a data base…)

ORGANISERS: MINISTRY OF INFRASTRUCTURE AND CONSTRUCTION; European Commission; Instytut Badawczy Dróg i Mostów, Road and Bridge Research Institute; CEDR Conférence Européenne des Directeurs des Routes, Conference of European Directors of Roads; ERTRAC European Road Transport Research Advisory Council; ERRAC The European Rail Research Advisory Council; WATERBORNE TP; alice Alliance for Logistics Innovation through Collaboration in Europe

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