Suivi de l’endommagement de structures de chaussées par techniques radar Ultra-large bande

(Monitoring the structural pavement conditions by Ultra Wideband Radar techniques)

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1. PROBLEM STATEMENT
- Degradation of roads due to environmental and other factors (traffic, time, etc.)
- Need for early and efficient detection of sub-surface defects

2. OBJECTIVES
- Detection of thin sub-surface defects
- Monitoring defect growth over time
- Improve the radar’s detection capability to detect smaller defects
- Use of high frequencies (UWB range) along with advanced data processing techniques
- Development of semi-automatic detection methods

3. DEVELOPED METHODS
Conventional Method
Amplitude Ratio Test (ART)
- Two ratios: $A_{H1}/A_{surf}$ and $A_{H0}/A_{surf}$
- Classification threshold to identify defective A-scans

Advanced Processing Method
Support Vector Machines (SVM)
- Supervised machine learning
- Learning and Testing stages
- Linear and non-linear kernels

4. EXPERIMENT DATABASES
- Numerical data model (GPILE\(^{[1]}\))
- Experiments
  - Ground Penetrating radar (GPR)
  - Step-frequency Radar (SFR)

5. RESULTS
- Experimental setup
  - GPR (Bituminous slabs, Cerema)
  - SFR (Fatigue carousel, IFSTTAR)
- Interpretation of results\(^{[3]}\)
  - Confusion Matrix
  - Performance indexes

6. CONCLUSIONS
- Conventional & Advanced processing methods provide good detection results (SVM > ART)
- Successful detection of debondings with thicknesses [0.5 ~ 1] cm

Perspectives
- Propose semi-automatic method with better performance to reduce false detections (for both GPR and SFR)

7. PUBLICATIONS
- Detection of Deobndings with Ground Penetrating Radar using a Machine Learning Method, IWAGPR 2017
- Comparative study of classification algorithms to detect interlayer debondings within pavement structures from Step-frequency radar data (submitted at IGARSS-2018)
- Currently writing an article for the NDT&E journal

