AI-based Model for the Estimation of Pavement Elastic Modulus from Deflection Velocity Measurement *

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JOURNEES TECHNIQUES ROUTE 2024

Université Gustave Eiffel

1 Challenges: EU's Road infrastructure

Deteriorating roads, limited budgets, insufficient data for maintenance planning & investment strategies

❑ Socioeconomically, France spent + 300 B € on road transport (Top sector in Greenhouse gases)

❑ Efficient road infrastructure management needs automated assessments and reliable indicators

2 TSDDs: Network-level of PMS

TSD overcomes FWD limitations, but current measurement interpretations prove impractical

I. Continuous bearing capacity Assessment

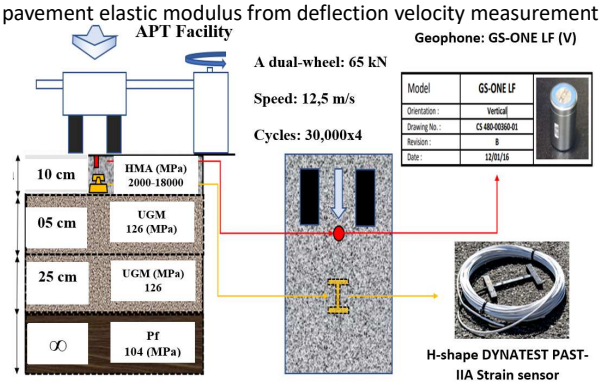
II. Measurement at traffic speed (80 km/h)

III. Secure with no traffic disruption

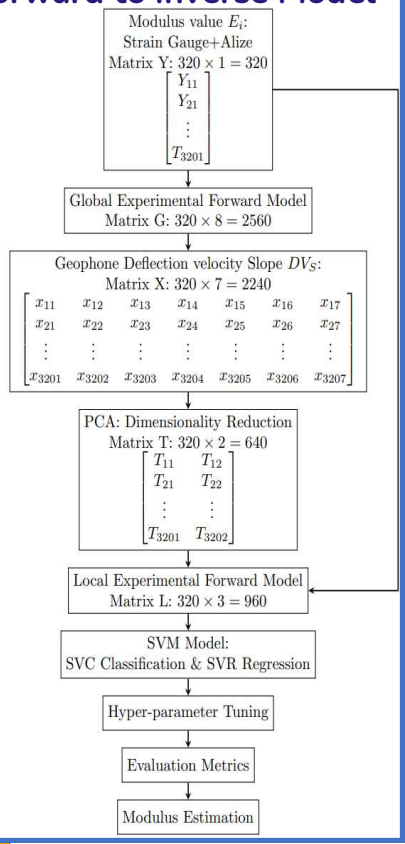
IV. Cost-effective for projects and networks

3 Objective: $AI\ (ML) + TSD\ (D_V) \longrightarrow E_i$

Development and Implementation of (AI + TSD) model to estimate pavement elastic modulus from deflection velocity measurement

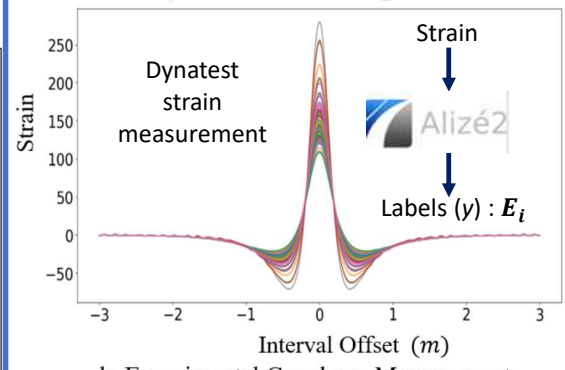


4 Methodology: Forward to inverse Model

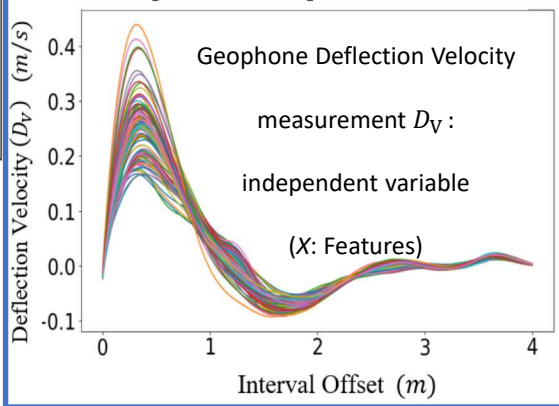


5 Forward Model construction: Experimental Database

a. Experimental Strain Gauge Measurement



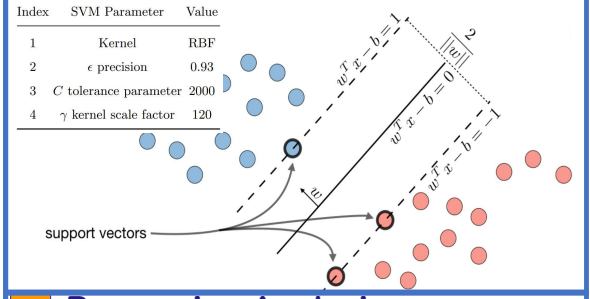
b. Experimental Geophone Measurement



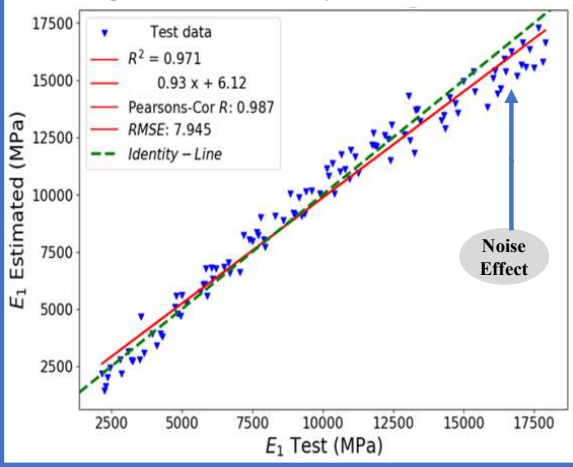
6 ML Model: SVM (SVC & SVR)

Unlike conventional methods, ML models provide superior accuracy, computational efficiency, and generalization

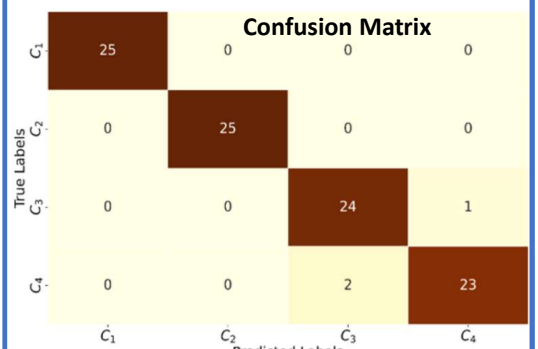
Index	SVM Parameter	Value
1	Kernel	RBF
2	ϵ precision	0.93
3	C tolerance parameter	2000
4	γ kernel scale factor	120



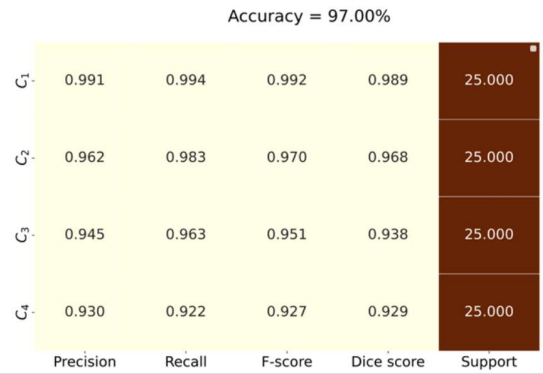
7 Regression Analysis



8 Classification Analysis



9 Evaluation Metrics



10 Conclusion & Perspectives

i. This research is among the first studies that have been developed to showcase AI/ML Efficiency in estimating pavement structural conditions using deflection velocity data (TSD)

ii. Sensitivity analysis has accounted for factors such as measurement noise, temperature, data-size, other layers (E_i) value uncertainty…

iii. For generalizability, future research could incorporate TSDDs measurement data from France territory, as the model could be applicable to it

*A. ABDELMUHSEN, J-M. SIMONIN, F. SCHMIDT, D. LIÈVRE, A. COTHENET, A. IHAMOUTEN, On the variants of SVM method for the estimation of soil elastic modulus from TSD model: Numerical parametric study, Transportation Engineering, Volume 13, 2023, 100187, ISSN 2666-691X, https://doi.org/10.1016/j.treng.2023.100187.

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