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

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1 Challenges: EU's Road infrastructure

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



- 2022, France spent + 300 B € on road transport
- Efficient road infrastructure management needs automated assessments and reliable indicators

2 TSDDs: Network-level of PMS

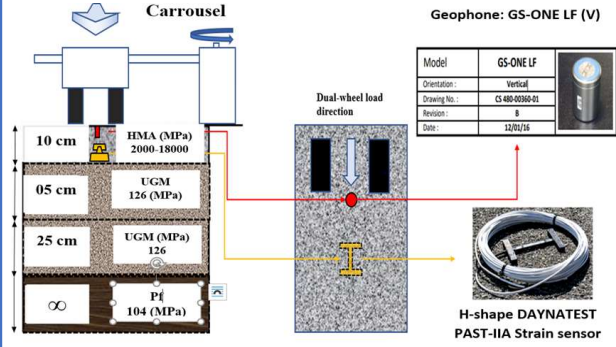
TSD overcomes FWD limitations, but current measurement interpretations prove impractical

- Continuous bearing capacity Assessment
- Measurement at traffic speed (80 km/h)
- Secure with no traffic disruption
- Cost-effective for projects and networks

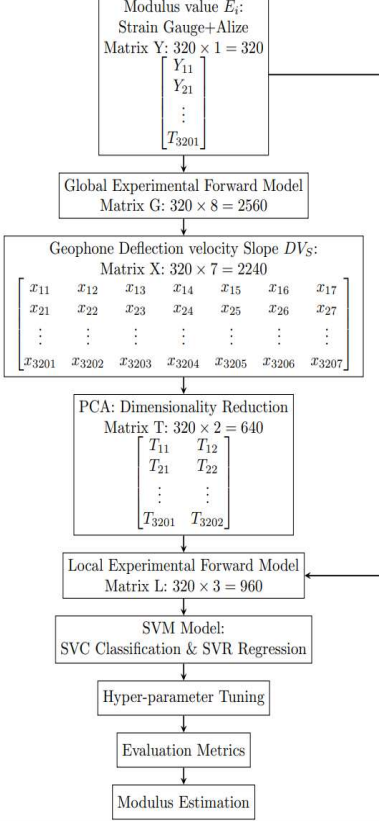


3 Objective: ML + TSD = E_i

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

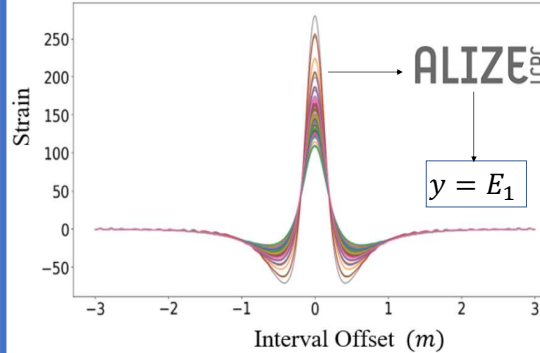


4 Methodology: Forward to inverse Model

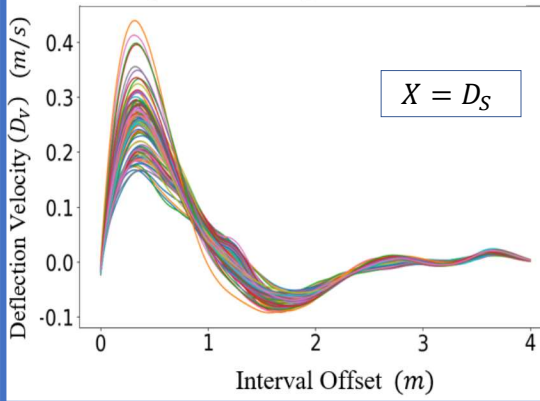


5 Forward Model construction Experimental Database

a. Experimental Strain Gauge Measurement

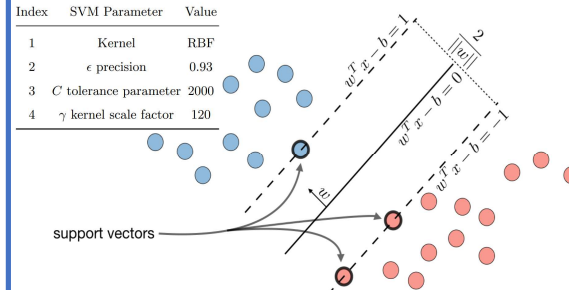


b. Experimental Geophone Measurement

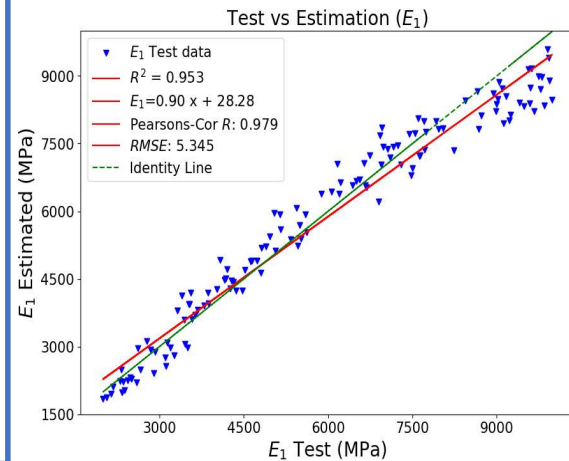


6 ML Model: SVM

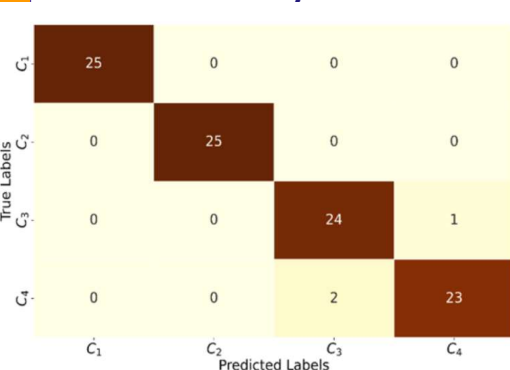
Unlike conventional methods, ML models provide superior accuracy, computational efficiency, and generalization



7 Regression Analysis



8 Classification Analysis



9 Evaluation Metrics

Accuracy = 97.00%

C_1	0.991	0.994	0.992	0.989	25.000
C_2	0.962	0.983	0.970	0.968	25.000
C_3	0.945	0.963	0.951	0.938	25.000
C_4	0.930	0.922	0.927	0.929	25.000
	Precision	Recall	F-score	Dice score	Support

10 Conclusion & Perspectives

- This research among the studies that have been developed to showcase AI/ML Efficiency in estimating pavement structural conditions using deflection velocity data (TSD)
- Sensitivity analysis has accounted for factors such as measurement noise, temperature, data-size, other layers (E) value uncertainty...
- For generalizability, future research should incorporate Raptor measurement data from France territory as the model could be applicable it

*A. ABDELMUHMEN, 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>.

