Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

Road pavement performance prediction using a time series long short-term memory (LSTM) model

Chuanchuan HOU, Huan WANG, Wei GUAN, Jun CHEN

Cite this as: Chuanchuan HOU, Huan WANG, Wei GUAN, Jun CHEN, 2025. Road pavement performance prediction using a time series long short-term memory (LSTM) model. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 26(5):424-437.
https://doi.org/10.1631/jzus.A2300643

Raw PI data for pavements

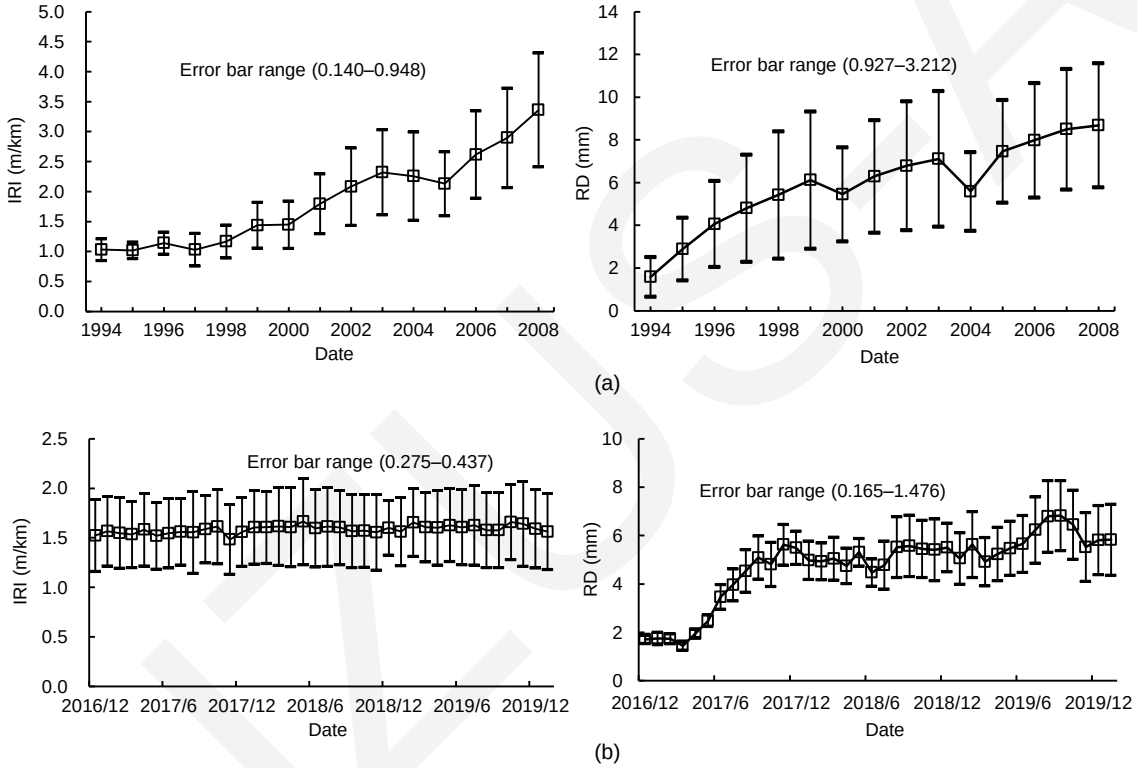

Fig. 1 PI data for pavement sections: (a) MnRoad (27 samples); (b) RIOHTrack (19 samples)

Predictors for PIs of pavements

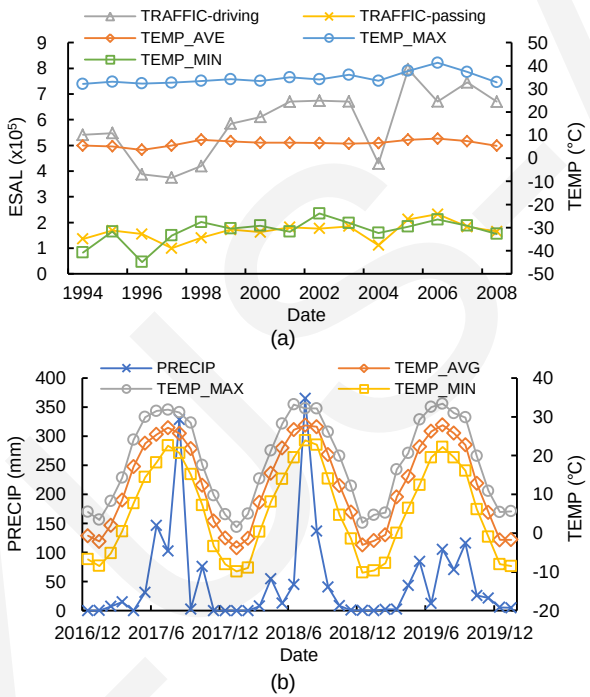

Fig. 2 Representative predictors for pavement sections: (a) MnRoad; (b) RIOHTrack

Method: Wavelet denoising

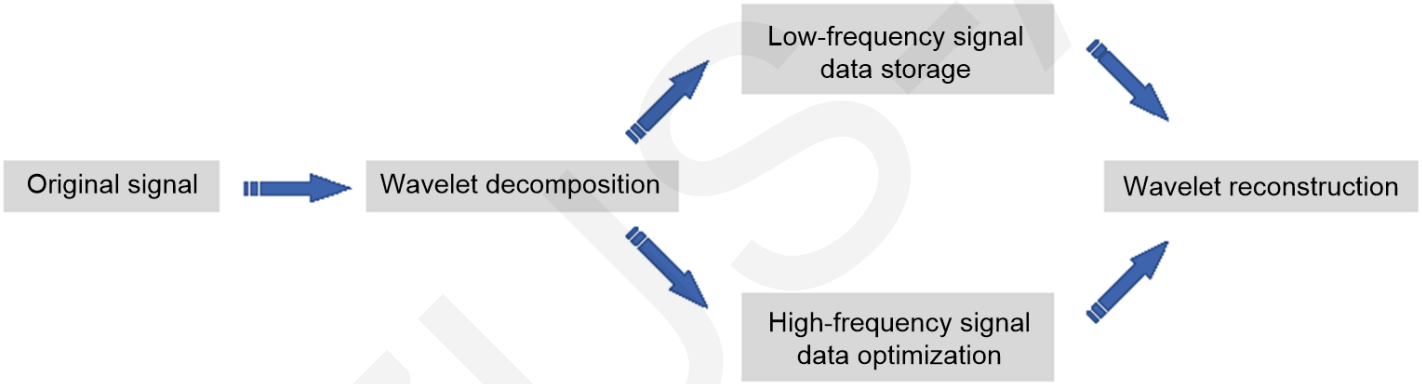

Fig. 3 Process of wavelet denoising

Result: PI predictions

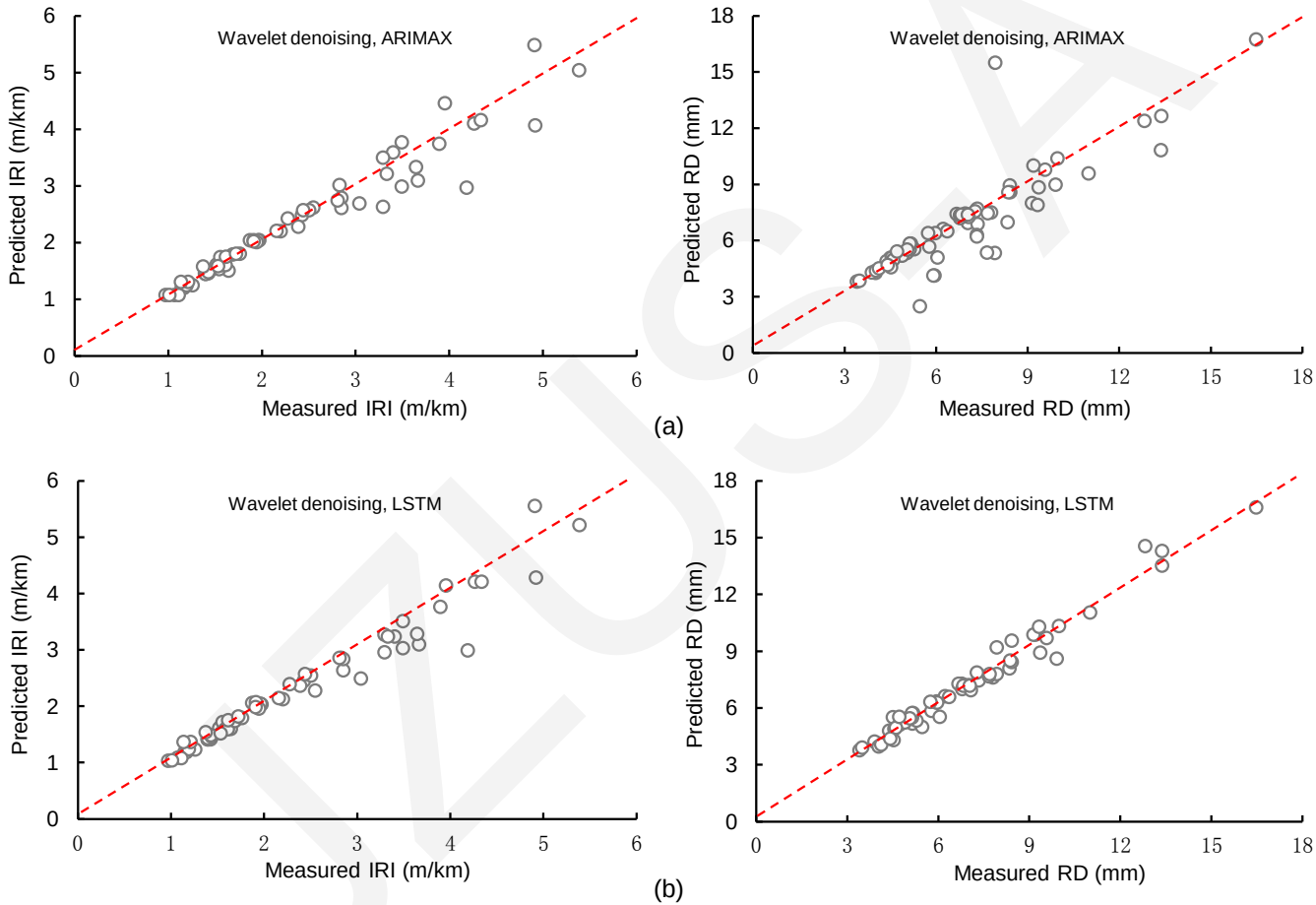

Fig. 9 Model performance for denoised PI prediction: (a) ARIMAX; (b) LSTM

Result: Comprehensive performance predictions

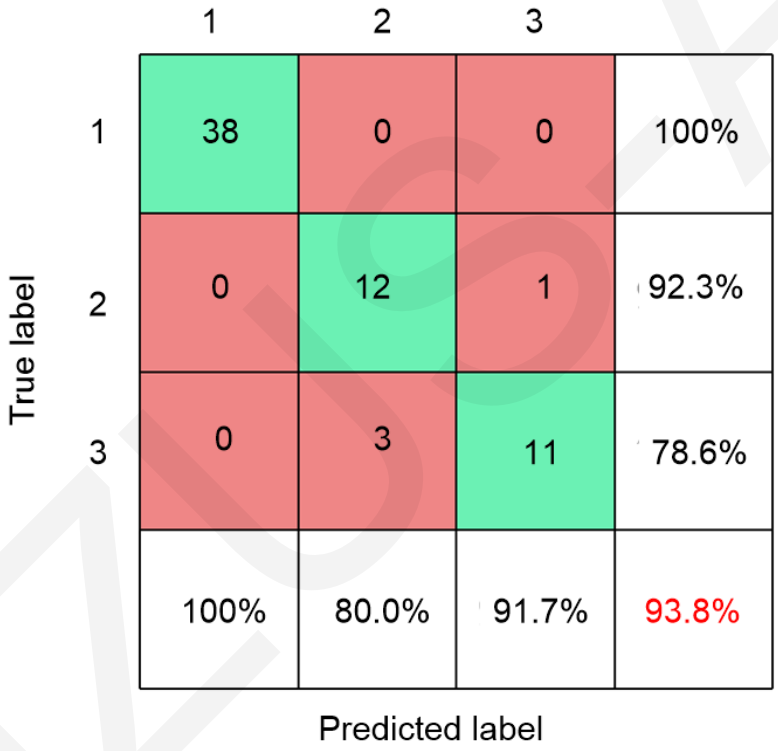

Fig. 10 Confusion matrix of the BPNN prediction model for comprehensive performance

Conclusions

- A method based on a time series LSTM model was developed to predict the PIs of asphalt pavements (specifically IRI and RD), and a comprehensive performance indicator PQI was proposed to evaluate the condition of the pavement.
- LSTM model outperforms the ARIMAX model in PI prediction.
- LSTM model is particularly suitable for application scenarios with missing/noisy data or frequent maintenance operations.
- PQI proposed in this study has an overall prediction accuracy of 93.8%, which may serve as a reference for more sophisticated pavement management and maintenance strategies.