

Railway track quality, safety and reliability through train-track dynamics and advanced machine learning

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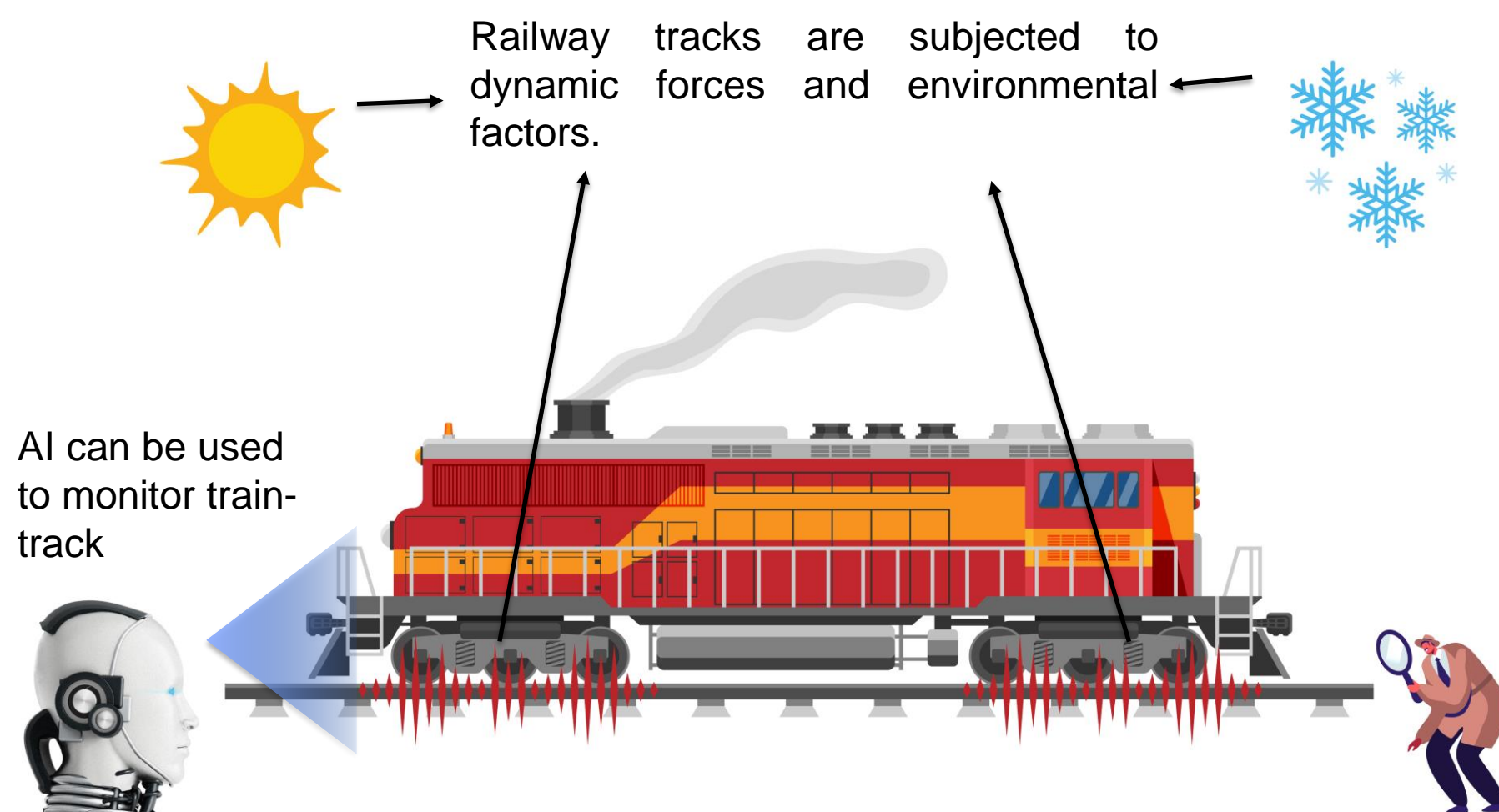
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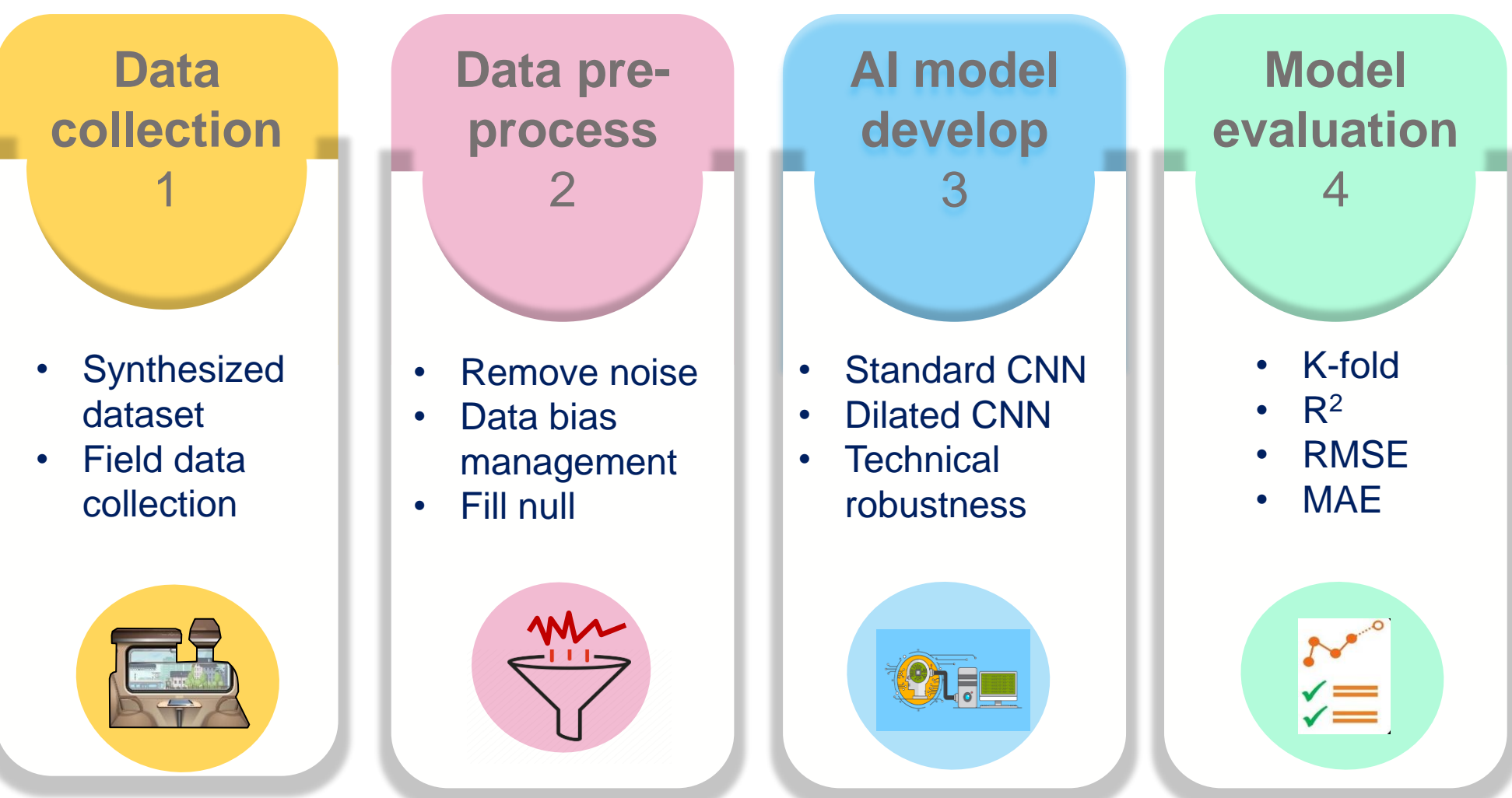
Research Questions

1. How do characteristics, quality and reliability of railway tracks impact system performance?
2. What are the key factors influencing the tracks in dynamic operational conditions?
3. What benefits of leveraging AI in enhancing the performance of track?
4. How can AI be applied to determine real-time track conditions?

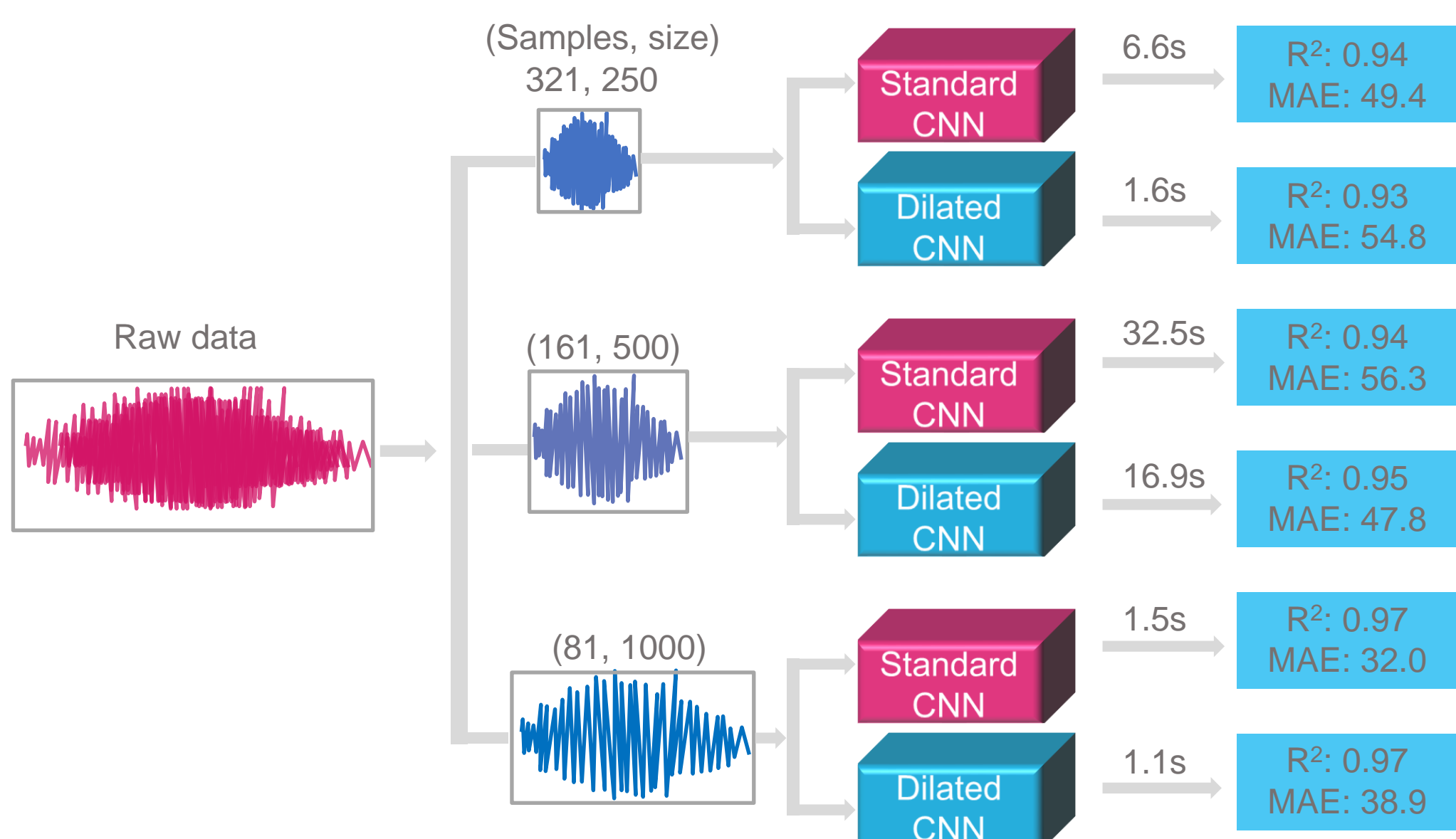
Contextual Background



Methods



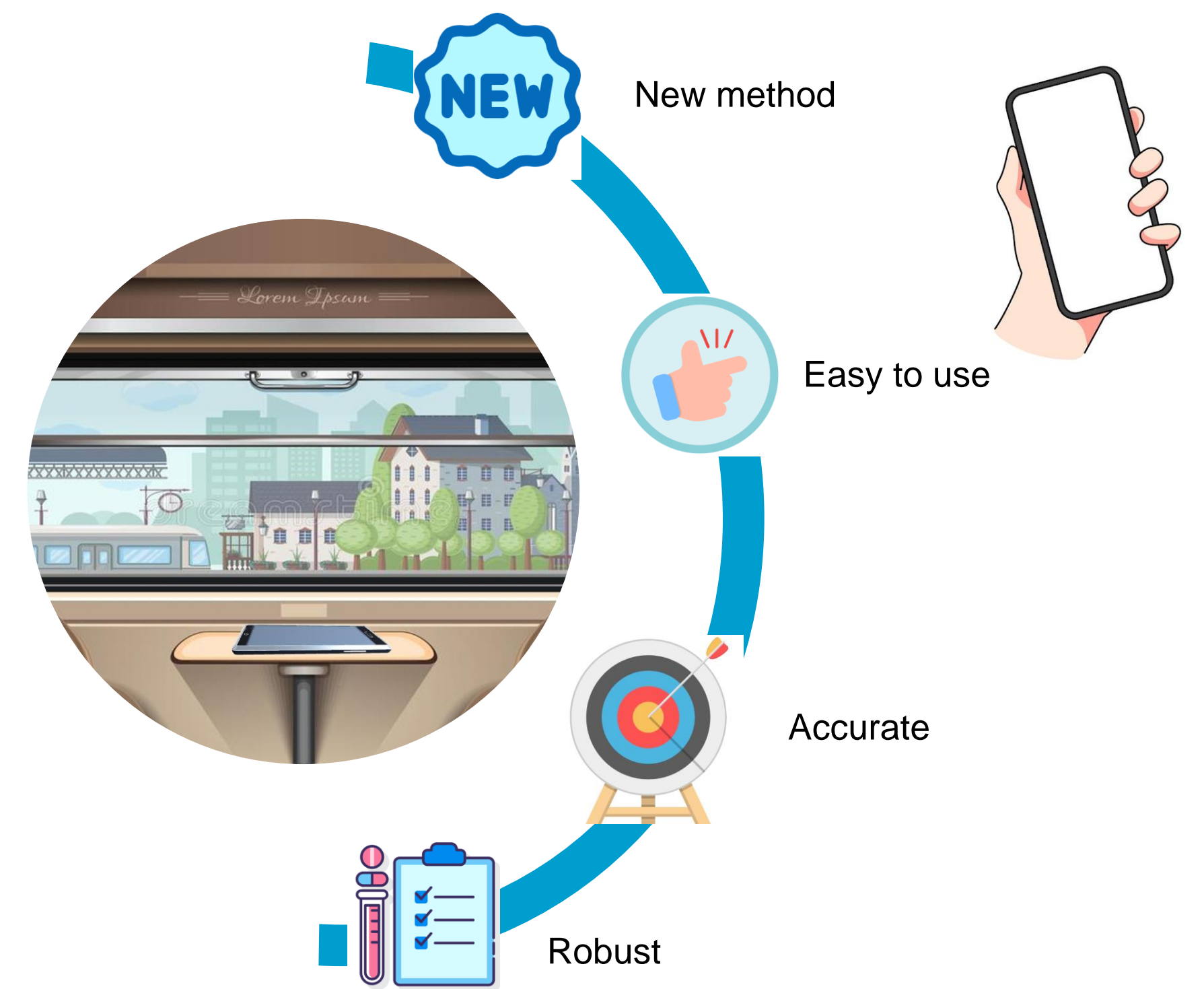
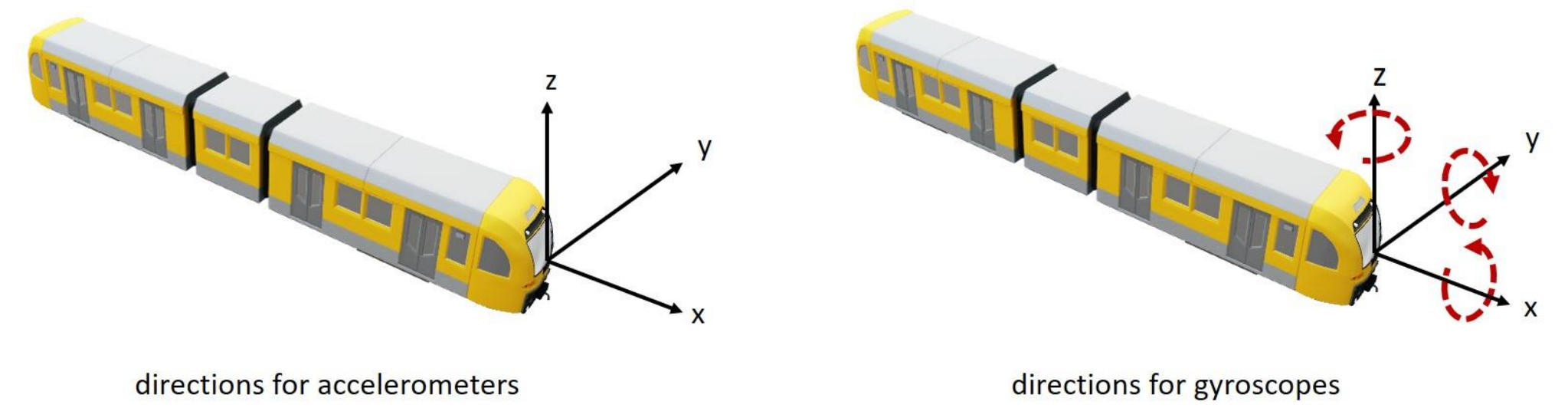
Results



1. Both the performance of the standard CNN and dilated CNN are above 0.90.
2. Considered factors: two different model types, three sample size, irregularities included.
3. Dilated CNN produces the best R² of **0.97** on the longest sample size.

The Findings in Context

New mobile-phone **App** for Real-time Ride Comfort Assessment



- AI models provide satisfied performance
- Fast calculation with full technical robustness
- Easy to implement and to connect real-time via **5G**
- Reducing cost, and Empowering passengers

Conclusions

1. We have proposed a dilated CNN using the sensory data acquired from axle box which is immune to speed up to 120 km/h and bad weather conditions as there are sophisticated accelerometers designed to tackle the extreme weather conditions.
2. We have confirmed that the performance of the proposed model is highly satisfied, the dilated technique contributes to saving computational cost, and the consideration of irregularities makes no significant difference to the model's performance.
3. An implication of this study is the possibility that wireless accelerometers can be mounted onboard service trains.
4. New smartphone App has been developed to assess real-time ride comfort using machine intelligence.

Key Publications

1. Huang J, Yin X, Kaewunruen S. Quantification of Dynamic Track Stiffness Using Machine Learning[J]. IEEE Access, 2022, 10: 78747-78753.
2. Huang J. and Kaewunruen, S. Evaluation of Railway Passenger Comfort With Machine Learning, in *IEEE Access*, vol. 10, pp. 2372-2381, 2022, doi: 10.1109/ACCESS.2021.3139465.
3. Huang J and Kaewunruen S. Train-ride quality evaluation of the Elizabeth Line using machine learning. *Front. Built Environ.* 8:1034433. doi: 10.3389/fbuil.2022.1034433