The International Specialized Exhibition "INFOINVENT"

A wind speed forecasting method along high-speed railways for instantaneous calculation and decision-making

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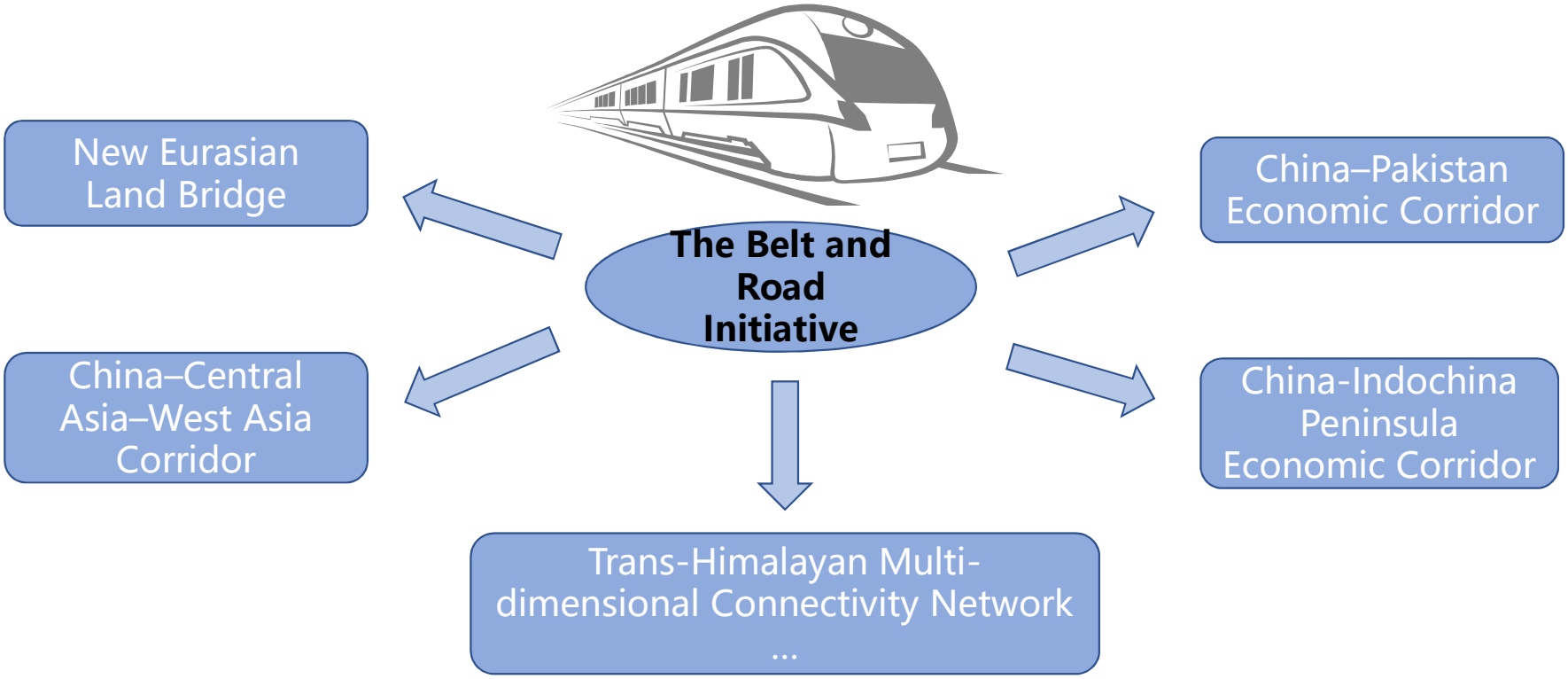
1 Technical Background

The Belt and Road Initiative is a global infrastructure development strategy adopted by the Chinese government to invest in nearly 70 countries and international organizations.



1 Technical Background

Railway is one of the most important infrastructure constructions under the Belt and Road Initiative.

- China-Laos Railway
- China-Thailand Railway
- Hungary-Serbia Railway
- Moscow-Kazan High-speed Rail
- Muse-Mandalay Railway
- Jakarta-Bandung Railway

Strong winds frequently threaten railway safety. Train accidents caused by strong winds have been widely reported in the media:

On February 28, 2007, a train running in southern Xinjiang railway derailed due to the force 13 wind, resulting in 3 passengers dead and 34 injured.

2 Technical Solution

The project serves the construction of Belt and Road Initiative, providing high-precision wind speed prediction to escort railway traffic.

Existing wind speed forecasting systems

Mostly based on statistical methods

Long calculation time, Poor generalization
Low multi-step prediction accuracy

The project

Integration of a variety of original technologies

Significantly improve the accuracy, robustness and real-time performance

Practical Applications

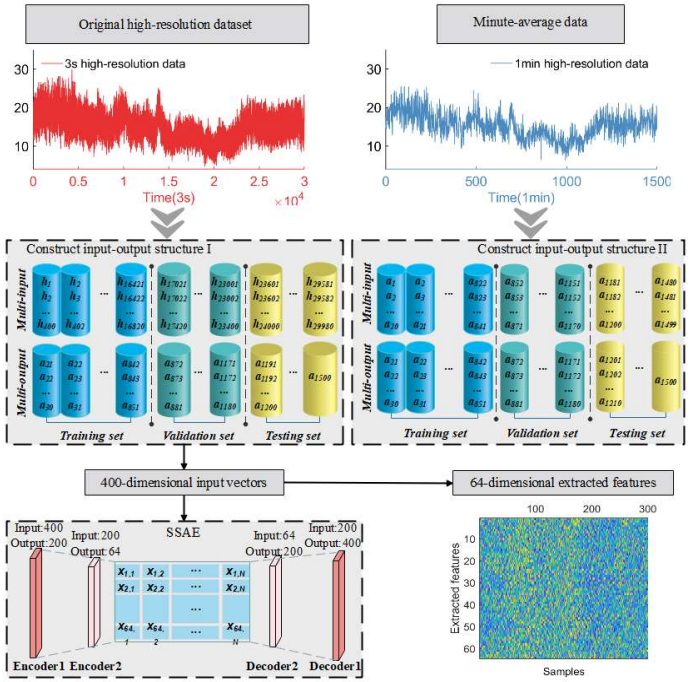
- Instantaneous wind speed prediction at a single site
- Coupled analysis of wind speed at multiple sites
- Future wind field simulation
- Adaptive screening of optimal models
- …

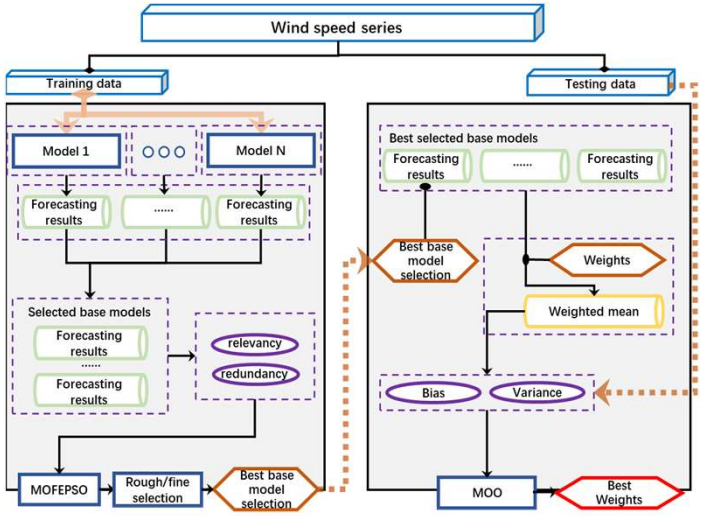
3 Novelty of the Patents

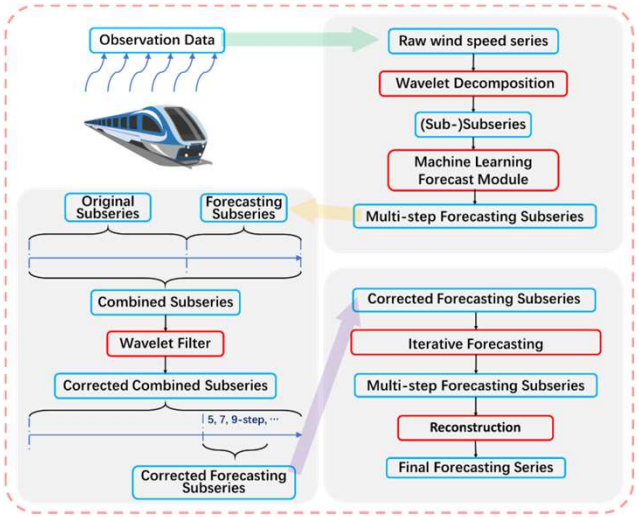
Original Technologies

- Compared with EWT-LSTM-ENN, WPD-VBA-MIMO, and other state-of-the-art technologies, the prediction error is reduced by 34.5%~ 50.0%.

High-resolution Data Auto-encoding → **Multiple Model Ensemble Learning** → **Large-step Adaptive Iteration**







Advanced technologies	1-step MAE	2-step MAE	3-step MAE
EWT-LSTM-ENN	0.3171	0.5524	0.7936
WPD-VBA-MIMO	0.3219	0.5246	0.7093
Our technology	**0.2076**	**0.3272**	**0.3967**

4 Names of the Patents

The project has been authorized 10 China national invention patents.

China National Invention Patents
A hybrid CFD and deep learning extreme wind speed prediction method and system
An intelligent adaptive matching prediction method for abrupt wind speed along high-speed railway
A large data clustering prediction method for extreme wind speeds along high-speed railways
A wind speed forecasting method along high-speed railways for instantaneous calculation and decision-making
A spatial clustering method of wind measurement station group based on image matching
An intelligent traversal large-step prediction method for the maximum wind speed along the high-speed railway
A multi-model and multi-feature fusion method for wind speed prediction along high-speed railway
A method for predicting wind speed spatial network construction along strong wind high-speed railway
An intelligent hybrid forecasting method for wind speed along high-speed railway
A high-precision prediction method for iterative competition of gale along high-speed railway

5 Certificates of the Patents

The project has been authorized 10 China national invention patents.

6 Contributions and Outlook

Contributions

- The developed wind monitoring and early warning systems have been applied for China’ s Lanzhou-Xinjiang Railway.
- Achieve technological breakthroughs for wind speed forecasting accuracy.
- Effectively ensure traffic safety along the Belt and Road railways.

Outlook

- Study the critical wind speed under different environments.
- Extend the technologies to more countries and regions.
- Integrated with big data to enhance prediction timeliness and provide faster calculation.