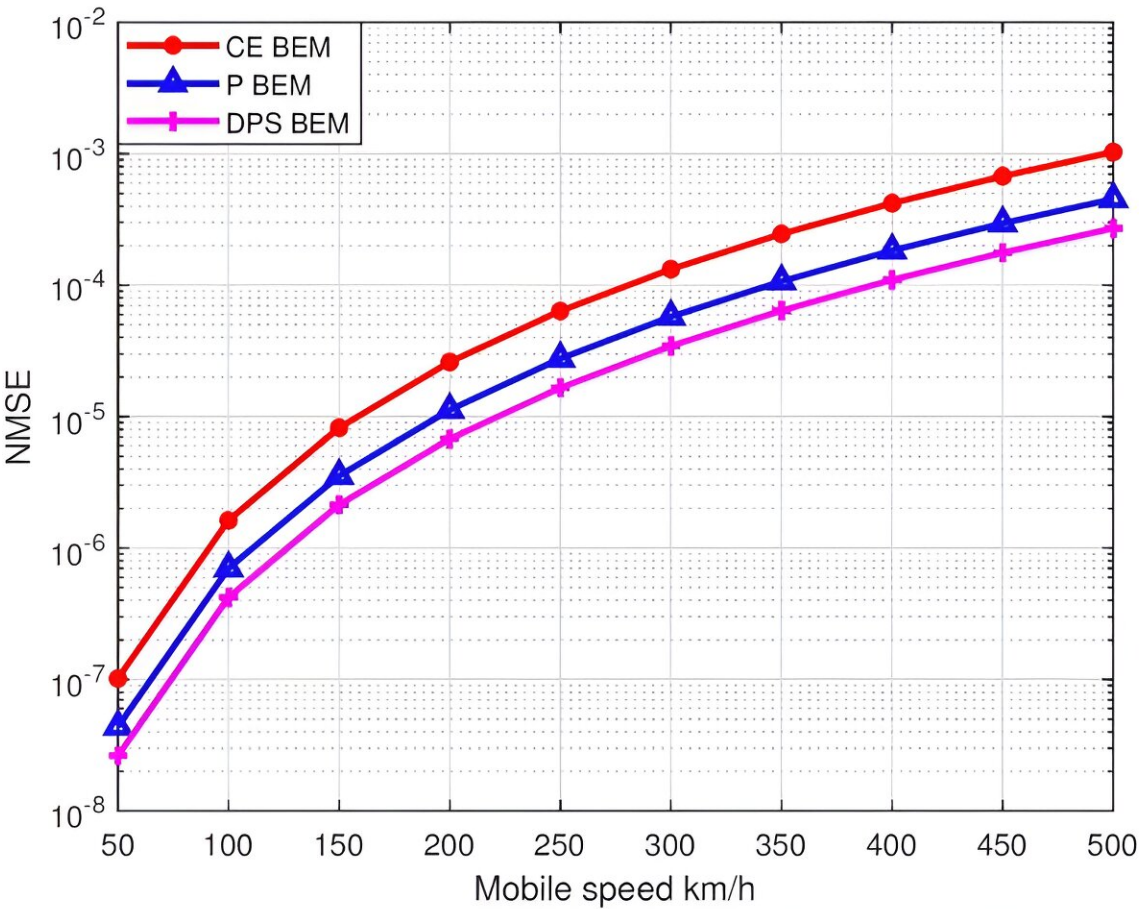


An overview of channel estimation technology in high-speed railway communications

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Influence of mobile speed on channel estimation error. Credit: Xuying Chen, et al.

To guarantee safe train operations and provide passengers with convenience, such as seamless internet service and robust entertainment options, there is an increasing need for high-reliability, high-data-rate wireless communications. Wireless communication technologies, for a significant part, heavily rely on the acquisition of channel state information (CSI), making channel estimation vital to their performance. However, offering satisfactory service to a large user base at high speeds presents various challenges.

In a study published in *High-Speed Railway*, a team of Chinese researchers has outlined the challenges, proposed solutions, and future development directions related to channel estimation technology in high-speed railway (HSR) [wireless communication](#).

"The HSR signal propagation environment is complex due to reflections from [physical objects](#) that cause time dispersion. These reflected signals can combine destructively, resulting in multipath fading. High data rate broadband signals may encounter frequency-selective multipath effects, while high mobility can lead to Doppler spread, inducing a time-selective channel," explains co-corresponding author of the study, Wei Chen.

"Channel estimation in HSR confronts challenges such as high estimation overhead and inter-carrier interference (ICI) within the orthogonal frequency-division multiplexing (OFDM) system."

The team also explored these channel features to achieve channel dimensionality reduction, refine traditional algorithms based on channel characteristics, and eliminate ICI for OFDM, thereby improving [channel estimation accuracy](#).

"Future [communication](#) systems should aim to advance the intelligent and digital progression of HSR, providing faster and more comfortable services to a multitude of simultaneous passengers at speeds reaching up

to 500 km/h or even higher," added Chen. "Orthogonal Time Frequency Space (OTFS) system and Reconfigurable Intelligent Surface (RIS) represent the most promising technologies to integrate with HSR."

More information: Xuying Chen et al, Wireless channel estimation for high-speed rail communications: Challenges, solutions and future directions, *High-speed Railway* (2022). [DOI: 10.1016/j.hspr.2022.11.004](https://doi.org/10.1016/j.hspr.2022.11.004)

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