# Pseudo-Measurement based State Estimation for Railway Power Supply Systems with Renewable Energy Resources

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## Abstract

State estimation is critical for railway power supply systems (RPSSs). Pseudo-measurement is commonly used in state estimation. However, the fluctuations of renewable generations and railway traction loads in RPSS may introduce data noise, which will jeopardize the accuracy of the generated pseudo-measurements and thus impact the state estimation. Additionally, when learning the historical measurement data sequences, the traditional pseudo-measurement model is likely to have overfitting, which will further impact the accuracy of pseudo-measurements, thereby affecting the accuracy of state estimation. To address these issues, this paper proposes a high-accuracy pseudo-measurement-based state estimation approach for RPSSs. Firstly, a denoising autoencoder (DAE)-based method is used to mitigate the impact of data noise on the accuracy of pseudo measurements, and a gated recurrent unit (GRU)-based method is used to adaptively learn the historical measurement data sequence, thereby improving the accuracy of pseudo measurements. Next, the pseudo-measurement weights are obtained by generating pseudo-measurement variances using the Gaussian mixture model. Finally, the pseudo measurements and real-time measurements are integrated by weighted least squares to realize the state estimation of RPSS. The effectiveness and accuracy of the proposed method are verified by simulation on a modified IEEE 33-node system which includes a railway traction substation and renewable generations.

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