

## Overload Overturning Risk Assessment of Single-Pier Bridges Based on Digital Twin Technology

\*Hua-Qiang Li<sup>1)</sup> and You-Liang Ding<sup>2)</sup>

<sup>1), 2)</sup> School of Civil Engineering, Southeast University, Nanjing, China

<sup>1)</sup> [lihq@seu.edu.cn](mailto:lihq@seu.edu.cn)

### ABSTRACT

In response to the increasing risk of overturning of single-column pier bridges due to the rise in traffic volume and the increase in heavy-load vehicles, this paper proposes a method for assessing the risk of overload overturning of single-column pier bridges based on digital twin technology. This method aims to achieve second-level assessment and rapid early warning of the overturning risk of single-column pier bridges under heavy-load vehicles. The paper uses the Local Outlier Factor (LOF) algorithm to filter out outliers collected due to system errors from the vehicle load data collected by the dynamic weighing system. Based on specifications and accident reports, the vehicle load data are subjected to K-means clustering analysis to screen out overweight vehicles. Using the overweight vehicle data as input and the Midas finite element model analysis results as output, with the adverse conditions of bridge overturning as the model evaluation basis, a bridge perception mapping based on neural networks is established. The results of the perception mapping for a four-span single-column pier bridge indicate that the mapping effect of the two-dimensional convolutional neural network is superior to that of the BP neural network and the one-dimensional convolutional neural network. The evaluation model method aligns with the actual conditions of the bridge, possesses greater robustness and practical application value, and enhances the timeliness and convenience of the analysis of bridge overturning.

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<sup>1)</sup> Graduate Student

<sup>2)</sup> Professor

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