Dynamic Displacement Monitoring Method Of High-Speed Railway Based On L1 Sparse Load Reconstruction

Xin WANG, Li SHUNLONG

The dynamic displacement monitoring of high-speed railway bridges is an important part of the bridge health monitoring system, and an important indicator for evaluating the bearing capacity of high-speed railway bridges and the safety of trains. In this paper, a dynamic displacement monitoring method for a 32-meter standard beam of high-speed railway based on l1 sparse load reconstruction considering the coupling effect of train bending and torsion is proposed. Considering the characteristics of the eccentric load distribution of the two-lane train load of the 32-meter standard girder bridge and the sparse distribution of the load outside the generalized node of the bridge deck, and on the finite element numerical simulation of Ansys, the strain and displacement influence lines of the box girder measuring points under the eccentric load of the train are extracted, the equivalent generalized nodal force loads on the bridge deck with a specific spatiotemporal distribution are inverted based on the strain influence line and the l1-regularized sparse reconstruction theory, the full bridge displacement field is reconstructed based on the equivalent generalized nodal force load and the displacement influence line of the target measuring point. The location selection of the strain measuring points on the bottom plate of the box girder has a significant impact on the reconstruction accuracy of the equivalent generalized nodal force load and the displacement of the full bridge, and the genetic algorithm (GA) is used to optimize the number and location of the strain measuring points. The Universal Mechanism multi-body dynamic simulation model data set and the dynamic load test results of a 32-meter standard beam show that the displacement reconstruction value of the key points based on the method proposed in this paper is in good agreement with the measured value, which verifies the effectiveness and accuracy of the algorithm proposed in this paper.