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Global Displacement Reconstruction Of A Lattice Tower Using Limited Acceleration And Strain Data Based On A Novel Data Fusion Method

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Displacement is an important parameter for evaluating structural performance. However, the accurate measurement of the global dynamic displacement remains a challenging task. To solve this problem, this paper proposes a global dynamic displacement reconstruction method for lattice tower structures, fusing limited acceleration and strain data. First, the strain-displacement mapping method based on strain data for cantilever beam with variable cross-section is presented and extended to the lattice tower. Thereafter, a modified multi-rate data fusion algorithm is developed to fuse the acceleration and strain data to reconstruct the global dynamic displacement of the tower incorporating the Kalman filtering and the strain-displacement mapping methods. The influence of the number of strain sensors were also discussed to acquire more accurate reconstruction results. The numerical simulation and model test imply that the reconstructed dynamic displacements agree well with the reference values in both the time and frequency domains. When the signal-to-noise ratio (SNR) of signal is 5 dB, the relative error is only about 1.5%, quantitatively validating the effectiveness of the proposed method. Besides, a full-scale test of a 50 m-high transmission tower further proves the reliability of the developed method.