**Optimized Measurement matrix for Dynamic Response Reconstruction in Compressed Sensing**

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**Abstract.** High data transmission and storage cost caused by massive data collected is a critical problem in structural health monitoring (SHM). The data compression therefore offers a potential way to keep the SHM system running with high efficiency. The measurement matrix, one of the key element in the theory of compressed sensing (CS), is highly related with the accuracy of the original response reconstruction. Thus this paper aims to optimized the measurement matrix in CS for better reconstruction of dynamic response reconstruction in SHM. The compressed sensing theory was firstly introduced to reduce the sampling. Then, the conventional measurement matrix was optimized to reduce the coherence between the measurement matrix and sparse basis, which is benefit for accurately reconstructing the original dynamic responses with a limited sampling data. The field test data under ambient vibration of Ji'an Bridge were finally utilized to verify the feasibility and effectiveness of the proposed measurement matrix optimized method for compressed sensing in SHM. The studied results include: the reconstructed response based on compressed sensing agree well with the original response in time domain; when the compression ratio is more than 20%, the relative errors of the reconstructed response maintain less than 10%; the reconstructed responses using optimized measurement matrix provide higher accuracy than those using initial measurement matrix, especially in the case of lower compression ratio, result in reduction of data collection; the spectrum of the reconstructed response using optimized measurement matrix is smoother and matches well with the original response spectrum, and the peaks of the spectrum can be picked accurately; in contrast, the spectrum of the reconstructed response without optimization of the measurement matrix has more misjudgment of peaks, and some peaks even cannot be identified; the measurement matrix optimization method can be applied to random Gaussian matrix, Bernoulli matrix and sparse random matrix. The results demonstrate that the measurement matrix optimized method for compressed sensing in SHM is an effective way to accurately reconstruct original dynamic response with a limited sampling data.

**Keywords:** Civil engineering, Dynamic response reconstruction, Compressed sensing, SHM, Optimized measurement matrix, Ambient vibration.