Damage Detection Of Spatial Steel Structure Based On Temperature-Induced Strain

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Structural health monitoring (SHM) technology is an effective methodology to ensure the safe service of spatial structures. Under the multiple environmental factors such as solar radiation and air convection etc. , the temperature effect of spatial structures is very significant. A large amount of long-term data from the SHM system shows that the temperature-induced (T-induced) response is one of the main components of structural response (eg. strain or displacement). Most current SHM methods try to remove temperature-induced parts from the overall responses, and then use the residuals to evaluate the damage of the structure, which often fail in practical applications due to the removal of active ingredients in the data. Since the T-induced responses are related to structural stiffness, a new approach was proposed to identify stiffness damage of spatial structure. Firstly, the temperature-induced components have been separated from the overall strain response data use the multi-resolution analysis combined with blind source separation; then based on the temperature-induced parts of the health status (a priori) data, the data in the future unknown state have been predicted by nonlinear autoregressive with exogeneous inputs neural network (NARX). Finally, the analysis residuals are constructed using the compartion of the predicted data and the measured responses, and the t-test is assumed to provide early warning of structural damage. The analysis results show that the method proposed in this paper can take full advantage of the main components of the structural response in the natural environment, and effectively identify the support damage and the member damage of the spatial structure, and less affected by noise, which expected to realize real-time structural monitoring.