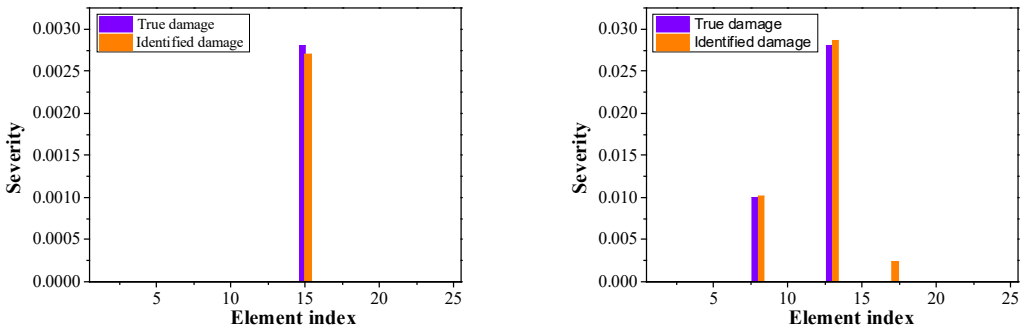
Inverse Analysis for Damage Identification Using MOPSO

Yang Zhang (Ph.D. student), Jiong Tang (Professor)
Department of Mechanical Engineering, University of Connecticut

Abstract

The overarching goal of this research is to utilize the piezoelectric actuator to detect damage in railway track. Here we demonstrate the damage detection and identification mechanism. The piezoelectric transducer is attached to the host structure and used as an active sensor to acquire admittance data, in which the damage information is included. By comparing the measurement information and finite element-based prediction under sampled damage index and minimizing the difference, we can identify the damage location and severity simultaneously. The damage index vector is sparse in nature because the damage in the structure only affects a small area. Therefore, the zero norm is defined to determine the sparsity for the damage index vector. Thus, the inverse identification process forms a multi-objective optimization problem, which is solved using multi-objective particle swarm optimization algorithm (MOPSO). Population initialization method is developed to make it suitable to solve the discrete objective function, the zero norm. Two cases are conducted to verify the proposed method. As shown in the picture, the algorithm identifies the damage location and severity with high precision. These results demonstrate accuracy and robustness of MOPSO for piezo admittance-based damage identification. This approach can be applied directly to railway track.



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References

[1] P. Cao, S. Qi and J. Tang. Structural damage identification using piezoelectric impedance measurement with sparse inverse analysis. Smart Materials and Structures, 2018.