

Simulations and Experiments on Wire Breakage Monitoring of Cable by Using AE

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Summary

Cables are one of the most vulnerable elements of cable-supported bridges. It is an urgent need to develop non-destructive techniques to monitor possible breakage of wires of cable. Acoustic Emission (AE) technique is a non-destructive monitoring method to detect internal damage of materials based on transient elastic waves propagation generated by sudden stress release in materials. However, some obstacles still exist when applying AE technique to bridge cables. For example, waveform characteristic of acoustic propagation mechanism are not clearly understood; AE database for wire breakage, friction and hitting are lacking; prediction and alarming methods of cable wire breakage are not established. Therefore it is difficult to correctly predict the wire breakage according to AE signals. This paper numerically and experimentally investigated wire breakage monitoring of cable by using AE. First, the paper presented a numerical modelling technique of acoustic emission wave propagation, which is the essential step to set up the baseline acoustic wave patterns for various types of cable damages. Then the experimental studies, including wire tension loading test and cable tension loading test, were followed. Finally, evaluation method on wire breakage was discussed.

Keywords: Cable breakage, Monitoring, Acoustic Emission, Simulation, Experiment.

1. Introduction

Cables are one of the most vulnerable elements of cable-supported bridges. There is an urgent need to develop non-destructive techniques to monitor possible breakage of wires of cable^[1, 2]. Acoustic emission (AE) technique is a non-destructive monitoring method to detect internal damage of materials based on transient elastic waves propagation generated by sudden stress release when a crack occurs in materials. It has been widely used for monitoring and evaluating the material damages of machine and civil structure systems. Recently, AE technique has been employed for monitoring main cables of suspension bridges or stay cables of cable-stayed bridges^[3]. However, some obstacles still exist when applying AE technique to bridge cables^[4, 5]. For example, waveform characteristic of acoustic propagation mechanism are not clearly understood; AE database for wire breakage, friction and hitting are lacking; prediction and alarming methods for cable wire breakage are not established. Therefore it is difficult to correctly predict the wire breakage according to AE signals^[6]. This paper numerically and experimentally investigated wire breakage monitoring of cable by using AE. First, the paper presented a numerical modelling technique of acoustic emission wave propagation, which is the essential step to set up the baseline acoustic wave patterns for various types of cable damages. Then the experimental studies, including wire tension loading test and cable tension loading test, were followed. Finally, evaluation method on wire breakage was discussed.