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Time Reversal Method for Arch Bridge Cables Inspection using Longitudinal Guided Waves

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Arch bridge cables consist of anchor heads, steel wires parallel arranged in an equilateral hexagon and hot-extruding PE sheathing layers outside the wires. The complex structure and contact force between wires aggravates the dispersion and attenuation of guided waves in steel wires. In order to reduce the attenuation of acoustical energy, below 80kHz low-frequency longitudinal guided waves is usually adopted. Low-frequency guided waves attenuate more slowly than high-frequency waves, but the received signal packets are wider and less recognizable. In this paper, the process of the time reversal method[1] is presented and the related parameters are calculated. Over a wide frequency range, using narrow-band pulse signals with different center-frequencies to drive comb-like magnetostrictive transducer array round the cable, extract the echo signals, which contains some feature information such as flaws, anchor heads, structural noise caused by contact force between wires. By taking advantage of the time-space compression characteristics of the method, the identification of anchor heads and flaws can be improved effectively and noise can also be decreased by driving the transducers again with the time reversed signal. Verification experiments show that the acoustical energy of guided waves can be focused on the position of flaws and the amplitude of flaws echo waves can be increased. At severe dispersion frequency, time reversal focusing process can improve the signal-noise ratio and suppress dispersion phenomenon caused by structural contact force.

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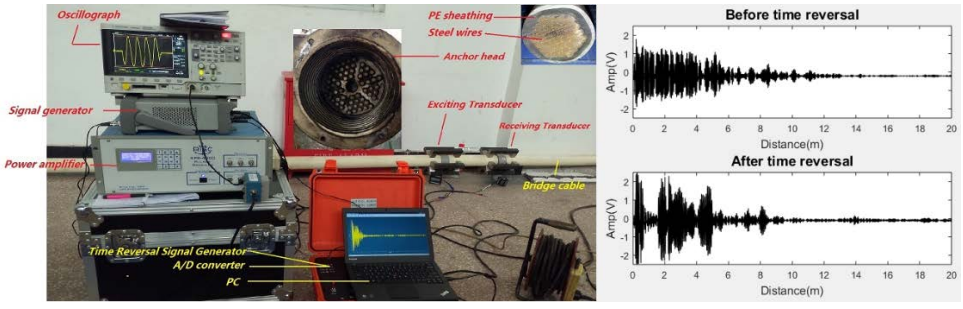

Figure 1. Experimental set-up of arch bridge cable inspection and signals

Reference:

1. Núñez, Ismael, and C. Negreira, “Efficiency parameters in time reversal acoustics: Applications to dispersive media and multimode wave propagation”, *Journal of the Acoustical Society of America*, 117 (3) pp.1202-1209, (2005).