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Damage detection for real operating bridge using nonlinear ultrasonic characteristics

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ABSTRACT

A fatigue crack detection is crucial for structural health monitoring to avoid a sudden failure of the structure. A nonlinear ultrasonic characteristic is used to detect the fatigue crack. When a fatigue crack occurs, the nonlinear interaction of a low frequency ultrasonic wave (LF) and a high frequency ultrasonic wave (HF) generates nonlinear ultrasonic characteristics at the difference and sum of the input ultrasonic frequencies. Then, a fatigue index is proposed using the continuity feature of nonlinear ultrasonic characteristic. Finally, a fatigue crack is diagnosed using the fatigue index. The proposed method is validated using a data acquired from real operating bridge, and the performance is evaluated. The proposed fatigue crack detection method has advantages as follows: (1) Reference free damage detection method based on nonlinear ultrasonic characteristic for real operating bridge, (2) Fatigue crack diagnosis without any user-defined parameters, and (3) Insensitive to noise interference.

Keywords: Fatigue crack detection, nonlinear ultrasonic characteristic, long-span bridge, lead zirconate titanate (PZT) sensor

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