The 2021 World Congress on
Advances in Structural Engineering and Mechanics (ASEM21)
GECE, Seoul, Korea, August 23-26, 2021

Cable damage detection using magnetostrictive transducer-based guided wave method

Xiao-dong Sui[1)] *Yuan-feng Duan[2)] Chung-bang Yun[3)] and Zhi-feng Tang[4)]

[1), 2), 3)] *College of Civil Engineering and Architecture, Zhejiang University, China*
[4)] *Institute of Advanced Digital Technologies and Instrumentation, Zhejiang University, China*
[1)] *11712067@zju.edu.cn*
[2)] *ceyfduan@zju.edu.cn*
[3)] *ycb@zju.edu.cn*
[4)] *tangzhifeng@zju.edu.cn*

ABSTRACT

Multi-wire cables are widely used as load-carrying members such as prestressed tendons and cables in the field of civil engineering. However, some local damages including wire breakage and corrosion may occur inside of the cable during the long service life under extreme environment, which will affect the carrying capacity of the structure. Magnetostrictive transducer-based guided wave method is presented for detection of cable damages considering that PZT cannot generate the wave along the whole cross section. A wave energy-based method is proposed for damage localization and severity assessment. The wave energy transmission coefficient at the damage location is presented as a measure for the damage condition. At first, a wave dispersion analysis was performed on a 7-wire strand using a semi-analytical finite element method, which provides the wave velocities and mode shapes of the wave propagation in the helical cable for a wide range of the excitation frequencies. Then, a magnetostrictive transducer was designed and used, which consists of a permanent magnet unit and a coil unit. Experimental studies were carried out on multiple cases of wire breakage and corrosion using pitch-catch method. It has been found that the locations and severities of the damages can be determined reasonably well using the time of flight information and wave energy transmission coefficients for the wave packets reflected from the damages.

[1)] Graduate Student
[2)] Professor
[3)] Professor
[4)] Associate professor