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Magnetostrictive Helical Array Transducers for Inspecting Spiral Welded Pipes Using Torsional Flexural Waves

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Wavefront analysis indicates that a flexural wave propagates at a helix angle with respect to the pipe axis. The expression for calculation of the helix angle for each flexural mode is given, and the helix angle dispersion curves for flexural modes are calculated. According to the new understanding of flexural guided waves, a magnetostrictive helical array transducer (MHAT) is proposed for selectively exciting a single predominant flexural torsional guided wave in a pipe and inspecting spiral welded pipes using flexural waves. A MHAT contains a pre-magnetized magnetostrictive patch that is helically coupled with the outer surface of a pipe, and an array of novel compound comb coils that are wrapped around the helical magnetostrictive patch. The proposed wideband MHAT possesses the direction control ability. A verification experiment indicates that flexural torsional mode T(3,1) at center frequency *f*=64kHz is effectively actuated by a MHAT with 13-degree helix angle. A 20-degree MHAT is adopted to inspect a spiral welded pipe, an artificial notch with cross section loss CSL=2.7% is effectively detected by using flexural waves.

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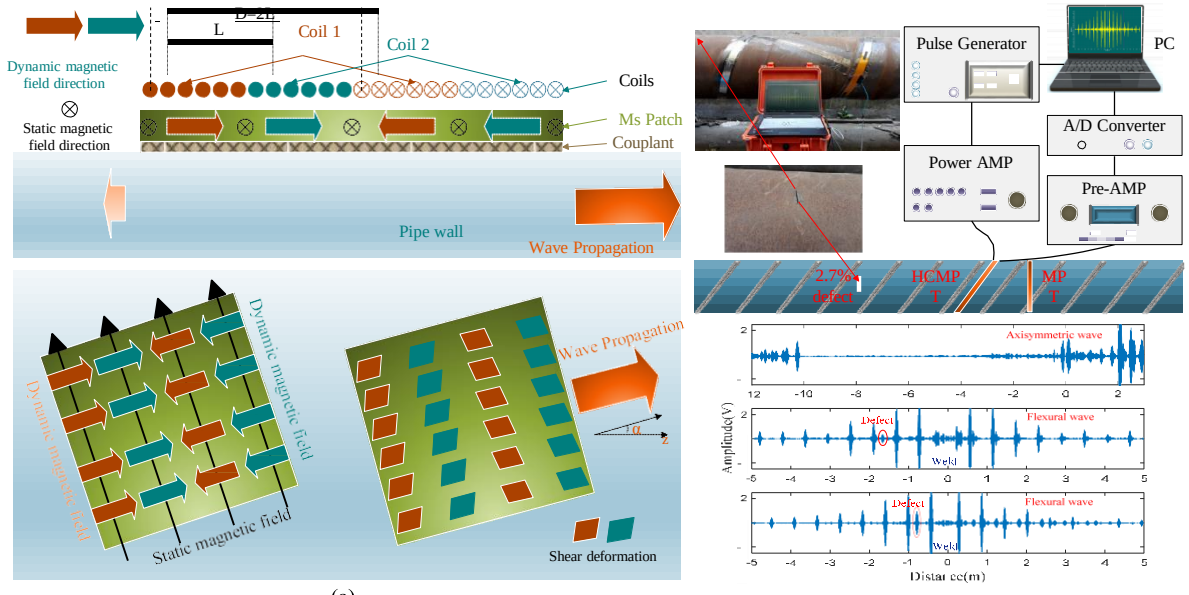

(a)

Figure 1. Magnetostrictive helical array transducer and spiral welded pipe inspection experiment

References:

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