Magneto-acoustic Fusion Sensing for Surface and Subsurface Defect Differentiation in the Ferromagnetic Material

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The conventional periodic permanent magnet (PPM) shear horizontal (SH0) guided wave electromagnetic acoustic transducer (EMAT) has a good detection capability for defects on both the surface and subsurface of the material. However, it is difficult to distinguish between surface and subsurface defects in the material using only the amplitude of the defect echo. In this paper, SH0 guided wave is excited using the SH0 guided wave EMAT with PPM configuration, which is used to achieve the detection and evaluation of defects on the surface and subsurface of ferromagnetic metal; on the other hand, the local magnetic field perturbation (MFP) effect of the PPM configuration on ferromagnetic material is fully exploited to achieve the identification of surface defects by picking up the MFP of the material at the defects. The proposed magneto-acoustic fusion effect sensor has an improved spatial magnetic field at both the mechanical construction and the magnetic sensor compared to the traditional magnetic flux leakage (MFL) detection method. Both simulation and experiment show that the proposed magneto-acoustic fusion effect sensing method based on the PPM configuration is capable of detecting the defects on the surface and subsurface of metal material, while the MFP effect in the fusion sensor can be used to help differentiate between the surface and subsurface defects in the material.