Modeling of Lamb Waves Excited by Inter-digital Transducers Deposited on Piezoelectric Plates

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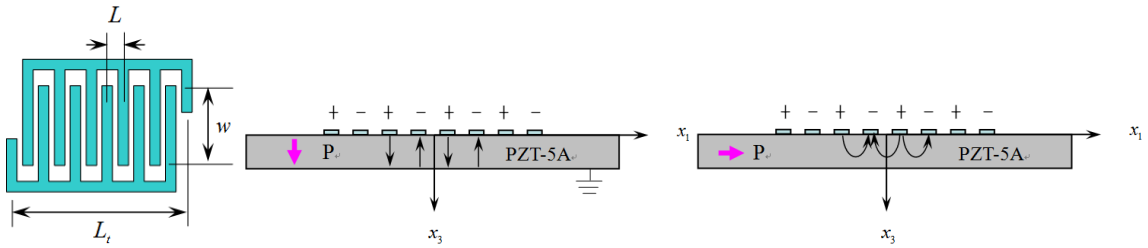
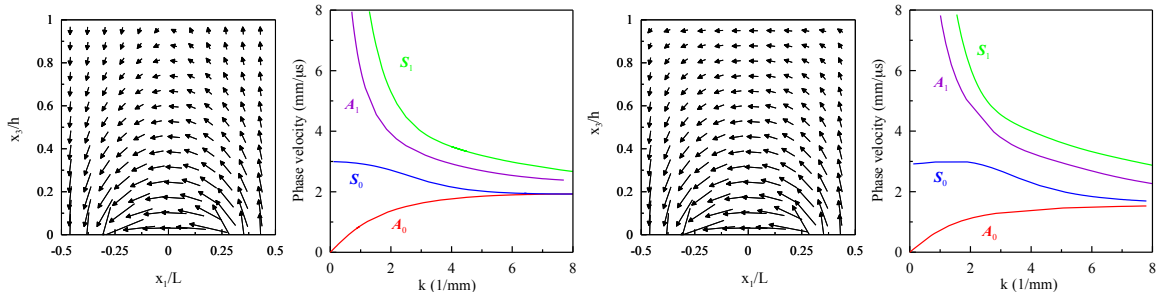
This thesis presents a study on Lamb waves excited by the inter-digital transducers deposited on piezoelectric ceramic plates in thickness mode and thickness shear mode. The Lamb wave response in frequency and time domains are evaluated numerically. Based on the approach provided by Engan (1969) [1] on electric field from a surface wave inter-digital transducer with small piezoelectric coupling assumption, the electric field induced by the inter-digital transducer on piezoelectric plates is solved and expressed in a series with the coefficients containing Legendre functions. The approximate electric potential on surface is employed as the continuous boundary conditions to evaluate the Lamb wave response generated in the piezoelectric plates. Computation of the frequency response of Lamb waves from inter-digital transducer is carried out through a one- dimensional wave number integration using a modified Clenshaw-Curits [2] numerical scheme. The time domain responses are calculated from frequency responses through the inverse fast Fourier transform. The S_0 mode excited by inter-digital transducer has response as large as the A_0 mode in piezoelectric plate of thickness mode. It is seldom found in the plate excited by time-variation of surface traction. The Lamb wave responses due to different numbers and widths of surface inter-digital transducers are also investigated.



(a)Top-view (b)Vertical polarization (c)Horizontal polarization

Figure 1. Inter-digital transducer on piezoelectric plate



(a) Thickness mode (b) Thickness shear mode

Figure 2. Electric field flow diagram and dispersion curves of piezoelectric plate

References

[1] H. Engan, "Excitation of elastic surface waves by spatial harmonics of inter-digital transducer," IEEE Transactions on Electron Devices, vol. ED-16 (12), pp. 1014-1017 (1969)

[2] J. Jin, S. T. Quek, and Q. Wang, "Analytical solution of excitation of Lamb waves in plates by inter-digital transducers," Proc. R. Soc. London, vol. A459, pp. 1117-1134 (2003)