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Numerical study of guided wave propagation in random elastic structures coupled with fluids

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ABSTRACT

The dispersion properties of ultrasonic guided waves, frequently used in examining prismatic structures, can undergo significant alteration owing to the spatial variability of material characteristics. This study introduces a probabilistic approach to investigate wave dispersion within uncertain, heterogeneous, anisotropic elastic cylindrical structures coupled with fluids. To do so, a random matrix model was adopted to incorporate stochastic variations in elastic properties along the radial axis. The semi-analytical finite element (SAFE) method was employed to compute wave dispersion within the fluid-elastic coupling system. SAFE method is shown to efficient to evaluate the phase velocity of guided waves within such cylindrical waveguides, even when considering coupling with inner and/or outer fluids. Compared with prior deterministic approaches in the literature, our probabilistic analysis framework enables estimation of the probability density function for the phase velocity of a particular mode.

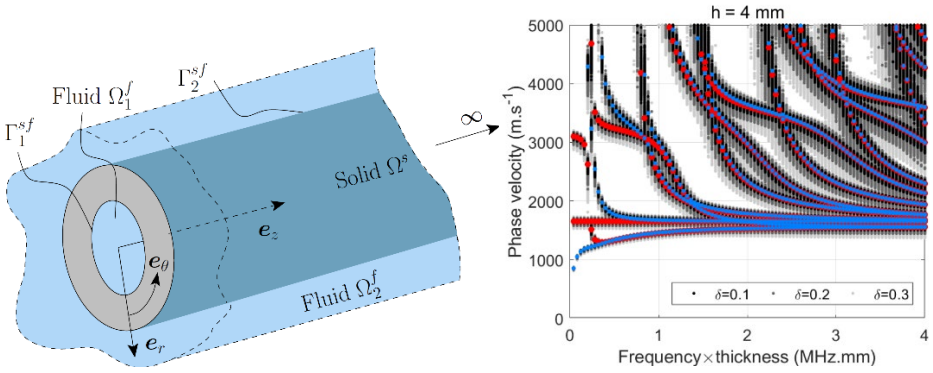

Fig. 1 (left) model geometry; (right) phase velocity computed for a 4mm-thickness random bone cylinder

REFERENCES

Seyfaddini, F., Naili, S., Desceliers, C., & Nguyen, V. H. (2024). Numerical study of guided waves in random anisotropic elastic cylinders immersed in fluids. *Wave Motion,* 127, 103288.