Coupling Ultrasonic Wave Propagation With Fluid-Structure Interaction Problem

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Abstract

In the present work, we propose a concept of coupling the ultrasonic wave propagation with the fluid-structure interaction (FSI) problem. First, we investigate the ultrasonic wave propagation in fluid-solid and their interface (the WpFSI problem). Further, we extend the study to account for the fluid-structure interactions. That is, the associated coupling is one-directional. The resulting model is referred to as the extended fluid-structure interaction (eXFSI) problem. In contrast to eXFSI, WpFSI is a strongly coupled problem, which comprises the evolution of acoustic and elastic waves. The ultimate contribution of the present work is the development of efficient and credible solution to the eXFSI problem, which we discuss in great details. Numerical solution is based on the combination of Finite Element and Finite Difference methods. Besides, we follow the monolithic approach, where at each time step the solution of the FSI problem provides boundary conditions for the WpFSI. An application example discussed here is computational support of on-line and off-line Structural Health Monitoring (SHM) systems for composite material and lightweight structure.

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