ABSTRACTS

The objective of our work is to provide an efficient simulation tool for the propagation of elastic waves generated by piezoelectric sensors in thin stratified plates or shells, in the context of Structural Health Monitoring (SHM). This method of Non-Destructive Testing (NDT), aiming at monitoring in-situ and periodically a structure, is increasingly present in many industrial fields, particularly in the aeronautics sector. Efficient simulation tools will be therefore increasingly needed for the transient simulations of elastic wave propagation. Such simulations can be used to improve the interpretations of the reception signals, to calibrate optimal control configuration or as building blocks of imaging processes.

Natural discretization procedures, for instance, based on low-order finite elements and explicit schemes can be really costly especially because of the relative small thickness of the plate. Based on high-Order spectral finite elements, we propose an efficient time discretization that treats explicitly the propagative phenomena in the in-plane direction and implicitly the phenomena occurring through the thickness. In our algorithm, the time step can be chosen independently of the discretization parameters along the thickness (this specific point is the bottleneck of explicit methods). The price to pay is to solve at each iteration a linear system which is decoupled into several small linear systems (that can be solved efficiently in parallel) for each interpolation point on the in-plane surface of the plate.

We will present numerical results showing the efficiency and accuracy of our approach on realistic applications. Finally we will discuss the potential extension of our method to plates with smoothly varying thickness or shells with small curvature.

KEYWORDS

Structural Health Monitoring | Elastodynamics | Finite element method | Time discretization |