Wave Propagation in Finite Element and Mass-Spring-Dashpot Lattice Models

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Numerical efficiency comparisons of a four-node finite element model (FEM), a mass-spring lattice model (MSLM), and a mass-spring-dashpot lattice model (MSDLM) are investigated. Specifically, an ultrasonic wave propagation model of an elastic solid is evaluated for phase speed error with variations in Poisson's ratio and angle of incidence. With regard to phase speed, materials having Poisson's ratios between 0.0 and 0.25 are modeled more accurately with the MSLM while materials with Poisson's ratios between 0.35 and 0.5 are modeled more accurately with the FEM. Materials whose Poisson's ratio is between 0.25 and 0.35 are modeled equally accurately with the FEM and MSLM. With regard to phase speed, viscoelastic materials modeled with FEM and MSDLM show good agreement. The computational expense of all three models is also examined. To measure computational cost, the number of floating point operations (FLOPS) is calculated for each of the different models. While the FEM and MSLM have nearly the same computation cost, MSDLM is 5 times as costly as either the FEM or MSLM.