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*A Helmholtz-decomposition based numerical method for Elastic wavefield separation*

In an elastic migration or inversion problem, the P and S waves are treated separately, thus efficient numerical solver is required to compute P and S wavefields. Direct solution of an Elastic wave equation is computationally costly, as it is a coupled system of partial differential equations (PDE). Numerical solution of such model is of great interests to both Mathematicians and Geophysicists working on a variety of applications, geophysical exploration for instance. In particular numerical modeling of Elastic wave equation is an integral part of full waveform inversion and other wave equation based seismic inversion methods. Here we propose a new method, in which we first use the Helmholtz decomposition to decouple the Elastic wave equation system into four scalar acoustic wave equations, which are then efficiently solved by compact higher-order finite difference method with high accuracy. Some novel boundary treatments have been developed for the new equations. The numerical solution of the Elastic wave equation is reconstructed from the previously obtained numerical solutions of the four scalar PDEs. Finally numerical examples are solved to demonstrate the efficiency and effectiveness of the newly proposed numerical method.