Numerical modeling of scattered elastic waves: Finite Element Method versus Finite Difference Method

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Various numerical techniques like the Finite Element Method (FEM) and Finite Difference Method (FDM) are applied in computational seismology and earthquake engineering. Despite its wide-spread use, it is yet unclear whether there is a difference in accuracy, computational cost, numerical stability and reliability between these methods. Therefore, we have compared the numerical results obtained by various explicit and implicit FEM and FDM methods investigating different heterogeneous geodynamical problems. A benchmark problem consisting of an elastic medium containing a weak circular inclusion, cf. Frehner et al. [1], outlines certain difficulties of the FDM method (i.e. spatial discretization) w.r.t. to accuracy. Classical FEM methods in space and explicit time discretization techniques show better numerical results in terms of accuracy and computational cost. Furthermore, implicit and explicit discontinuous space-time Galerkin FEM [2] are compared to the previous results of the classical FEM method.

Literature

[1] Frehner, M., Schmalholz, S.M., Saenger, E.H., Steeb, H., 2008, Comparison of finite difference and finite element methods for simulating two-dimensional scattering of elastic waves, *Physics of the Earth and Planetary Interiors*, DOI:10.1016/j.pepi.2008.07.003

[2] Chen, Z.Y., Steeb, H., Diebels, S., 2008, A new hybrid velocity integration method applied to elastic wave propagation. *International Journal for Numerical Methods in Engineering*, **74**, 56-79.