

Comparison of Finite Element Methods for Elastodynamics Problem

9.11 Qualitative and Quantitative Comparison of Numerical Methods for Solving Partial Differential Equations

Reza Abedi, Scott Miller

Linearized elastodynamics describes the spatio-temporal response of a solid elastic structure with infinitesimal strains. It seems that almost every computational method devised has been used for some application to solve the linearized governing equations of solid mechanics. But, which of these methods is the best? And what is meant by the "best" within the context of a computational method? We will discuss a variety of finite element computational methods for solving second order hyperbolic systems, using linearized elastodynamics as our test problem. Our discussion will focus on the possible choices a computational scientist can make: choice of primitive variables (1, 2, or more fields), spatial discretization method, and temporal discretization method. The focus of our comparison will be continuous versus discontinuous approximations in space, implicit versus explicit time integration, and how spacetime methods compare to more traditional approaches. The metric used for comparison will be computational cost versus accuracy, when compared to analytical solutions. The numerical energy dissipation would be another error measure. Other choices of metric will be discussed.