EXPLICIT DISCRETE DISPERSION RELATIONS FOR ACOUSTIC WAVE EQUATION IN d-DIMENSIONS USING FINITE ELEMENT, SPECTRAL ELEMENT AND OPTIMALLY BLENDED SCHEMES

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Abstract. We study the dispersive properties of the acoustic wave equation for finite, spectral and optimally blended schemes using tensor product elements defined on rectangular grid in d-dimensions. We prove and give analytical expressions for the discrete dispersion relations for the above mentioned schemes. We find that for a rectangular grid (a) the analytical expressions for the discrete dispersion error in higher dimensions can be obtained using one dimensional discrete dispersion error expressions; (b) the optimum value of the blending parameter is $p/(p+1)$ for all $p \in \mathbb{N}$ and for any number of spatial dimensions; (c) the optimal scheme guarantees two additional orders of accuracy compared with both finite and spectral element schemes; and (d) the absolute accuracy of the optimally blending scheme is $\mathcal{O}(p^{-3})$ and $\mathcal{O}(p^{-2})$ times better than that of the pure finite and spectral element schemes respectively.