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3D 4TH ORDER STAGGERED-GRID FINITE-DIFFERENCE MODELING OF SEISMIC MOTION IN VISCOELASTIC MEDIA WITH MATERIAL DISCONTINUITIES

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We present a new 3D 4th-order staggered-grid finite-difference scheme for the viscoelastic heterogeneous media with material discontinuities. The scheme is a generalization of the recently developed scheme (Moczo et al., in press) for the perfectly elastic media, which was shown, using extensive numerical tests, to be more accurate than standard staggered-grid schemes. The generalization is based on two key approaches: a) We assume that a contact of two viscoelastic media with the GMB (generalized Maxwell body) rheologies can be approximated by an averaged medium with the GMB rheology. The quality factors are determined from volume harmonic averages of the complex, frequency-dependent torsion and bulk moduli. The quality factors are then used to determine anelastic coefficients of the averaged medium. b) We define anelastic functions in a new way, which allows both Day's (1998) coarse spatial distribution (with a spatial period of 2h, h being a grid spacing) of the anelastic functions and accounting for all relaxation frequencies at any grid position of the anelastic function. This is important especially at the material discontinuities in order to avoid characterization of one medium by relaxation frequencies different from those, which characterize the other medium. We compare synthetics calculated for a set of test models with those calculated using a recent approach by Graves and Day (2002) and confront both with the DWN (discrete wavenumber) solutions.