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Six-component elastic-wave simulation and analysis

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In the seismic wave propagation, the particle motion includes not only three independent translational projections, but also three independent rotational projections. In this paper, we simulate seismic wave propagation in the elastic medium, including body and surface wave, and analyze the wave characteristics of all the six components. Based on the theory of first-order velocity-stress elastic wave equation, we use the absorbing boundary condition of the splitting complete matching layer (SPML) in our simulation. The calculation of the velocity and stress in the staggered grid finite difference scheme are deduced to simulate the six-component wave fields in both the isotropic and VTI media. And then the three-component dispersive-energy spectra in the two-dimensional isotropic two-layer model are obtained by a high-resolution linear Radon transform. The modeling results show that the energy of the rotational components is much weaker than that of translational components. On the translational components, surface waves are of stronger energy and lower frequency, while the P-wave energy is stronger and the S-wave energy is weaker. On the contrary, on the rotational components, the P-wave energy is weaker and the S-wave energy is stronger. The anisotropic parameters can greatly affect the rotational components. The dispersion energy spectrum of the rotational component contains more comprehensive information of the fundamental and higher modes, namely the rotational components carry more underground information.