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Amplitude-preserving P- and S-wave separation of elastic wave

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PP- and PS-wavefield independent imaging of elastic vector wavefield reverse-time migration need to separate P- and S-wave fields during wave field extrapolation. In isotropic media, P-wave is non-rotational field, S-wave is non-divergent field. P- and S-wave separation can be achieved by calculating divergence and curl of elastic wavefield during wavefield extrapolation. The divergence and curl operation of elastic wave field, which involve spatial derivative will results in a 90 ° phase shift and amplitude distortion, so the output P- and S-waves imaging results are not valid. In this paper, we present a P- and S-wavefield amplitude-preserving separation algorithm during elastic wavefield extrapolation. First, we add P-wave pressure and P-wave vibration velocity equation to the conventional elastic wave equation to decompose the P- and S-wave vectors. Then we synthesize the scalar P- and S-wave from vector P- and S-wave using Poynting vector according to the polarization direction of P-wave parallel to the P-wave propagation direction and the polarization direction of S-wave perpendicular to the S-wave propagation direction. At last, we obtain scalar P- and S-wavefield after amplitude-preserving separation. This method can ensure that the amplitude and phase of the separated P- and S-wavefield remain unchanged compared with the method that using divergence and curl operators. Numerical examples indicate that this method can achieve P- and S-wave true-amplitude decomposition and scalarization synthesis during elastic wavefield extrapolation; vector P- and S-wave after decomposition have the same amplitude and phase with horizontal and vertical components before decomposition; and the amplitude-preserving P- and S-wavefield can be used to elastic wave reverse time migration to obtain valid P- and S-wave imaging amplitude and phase.