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Modelling of single reflection by Tip Wave Superposition Method using effective coefficient

Seismic wave field simulation algorithms are usually developed in a way to allow inversion with respect to the model parameters. The purpose of such algorithms is to split the wave field to isolated wave events that could be directly referred to the elements of geophysical model. To provide this possibility, the Tip Wave Superposition Method (TWSM) was introduced for simulation of 3-D wave field scattered by curvilinear interfaces in terms of the scalar or vector surface integral [1, 3]. TWSM is based on the wave diffraction theory and thus particularly efficient for modelling on complex geological structures with steeply dipping reflectors, faults and high velocity contrasts.

Compared with earlier versions of TWSM, the improvements comprise a generalization of the background theory that also accounts for wave phenomena at critical reflections (head waves) and the replacement of the plane-wave reflection coefficient with the effective reflection coefficient (ERC) that eliminates diffraction artefacts at critical angles. It is shown that the high-frequency approximation of ERC generalizes corresponding plane-wave reflection coefficient to the case of curved reflecting interfaces, non-planar wave fronts and finite seismic frequencies and correctly describes near- and overcritical reflection phenomenon [1, 2].

To demonstrate that TWSM using ERC provides complete and accurate representation of a wave field, including reflection caustics, head waves and head-wave caustics, we exemplify the results of numerical modelling of 3-D wave fields single reflected by different types of curved reflecting interfaces [2]. Simultaneously, we give graphs comparing ERC to the plane-wave reflection coefficient.

References:

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3. Klem-Musatov K. D., Aizenberg A. M. Seismic modelling by methods of the theory edge waves. J. Geophys., 1985, V. 57, 90-105.

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