Scattering problem of waves in elastic media including passive cracks and active cracks

Masatoshi Miyazawa[1], Ichiro Nakanishi[1]

[1] Dept. Geophys., Kyoto Univ.

Scattering of wavefields in three-dimensional elastic media is numerically solved by use of boundary integral equation method (BIEM), where the media include passive structure and/or active structure. The passive structure of having scatterers generates scattered waves in response to incident waves, and the active structure contains endogenous fracture sources, which are dynamically triggered by stress changes due to wave propagation. Simple models are adopted to represent these structures: passive cracks act as scatterers and active cracks as internal fracture sources. A crack is formed by circular boundary which consists of many boundary elements. Scattering of elastic waves by the boundaries of passive cracks is treated as exterior problem. However, both exterior and interior problems must be solved to obtain wavefields generated by incidence of waves to active cracks, because they generate elastic waves due to fracturing with stress drop and growing crack boundaries scatter incident waves. Single scattering models result in that waves generated by the passive and active cracks have different influence on the amplitudes of first arrivals and codas. In case of passive cracks, energy of first arrivals moves to coda waves due to scattering, thus the amplitudes of first arrivals decrease and the coda waves increase. Active cracks have minor influence on first arrivals but major influence on the amplitudes of coda waves. We simulated wave propagation in passive structures and active structures, where passive cracks and/or active crack are randomly distributed in three-dimensional half-space elastic media. The structures include 25 passive cracks, 25 passive cracks + 1 active crack, 25 passive cracks + 5 active cracks, and 40 passive cracks. We suppose ak=1.27, where a is radius of a crack and k is dominant wavenumber of the incident wave. In active structures, multiple scattering between these cracks and waves due to fracturing have major influence on the amplitudes of first arrivals and coda waves.