Stress and displacement Green's functions to treat volumetric inelastic strain and elastic inhomogeneity in boundary integral equation method

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The boundary integral equation method (BIEM) is a commonly used method to simulate the fault motions accurately. Recent developments are now resolving well known problems of BIEM, such as the numerical cost problem (Sato and Ando, 2018) and the adaptabilities to elastic inhomogeneity (Kame and Kusakabe, 2012; Kusakabe and Kame, 2018). However, while it is shown to be applicable to the media other than homogeneous elastic media, obtained analytic integral kernels for simulating those media are now limited, largely due to its analytic difficulty. In this research, I obtain the the kernel expressions of those advanced BIEM in real space-time coordinate, based on the equivalent inclusion method (Eshelby, 1956; Mori and Tanaka, 1973).

First, the (volume) integral equation method (Barbot and Fialko, 2010) for the volumetric strain is shown to be reduced to BIEM of boundaries partitioning the discretized inelastic volume. Corresponding kernels are then obtained for piecewise-constant volumetric inelastic strain embedded in the three-dimensional homogeneous elastic space. The kernels are preliminarily shown to be equivalent to the part of the kernel for the inhomogeneous elastic media (Kame and Kusakabe, 2012; Kusakabe and Kame, 2018) both in static and dynamic cases.

Second, the surface integral in the representation theorem is reduced to the integral equation of the equivalent eigen-displacement. Consequently, as long as the absolute traction can be expressed with the strain and the eigen-strain, it is suggested that there can be a method to treat the inhomogeneous elastic media only by using the stress Green's function responding to the slip, already obtained analytically (Tada and Madariaga, 2001; Tada, 2006; Ando et al., 2007; Ando, 2016). By comparing the possible method with the method of Kame and Kusakabe (2012) capable of generally treating the elastic inhomogeneity in some examples, the validity of the proposal to treat inhomogeneous elastic media is investigated.

Keywords: volumetric inelastic strain, velocity structure, boundary integral equation method

