Rotational Ground Motion at Topographical Features for Incident Elastic Waves Using Boundary Integral Formulations

by

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ABSTRACT

The surface displacement fields at various topographical profiles under incidence of elastic plane waves (Rayleigh, P, SV and SH) can be computed using both the Indirect Boundary Element Method (IBEM) and the Method of Fundamental Solutions (MFS). In these approaches the diffracted or scattered field is constructed by means of discretized integral representations in terms of the Green function (which is the displacement at a given location due to a unit point load) and discrete force densities. Once such densities are obtained, the ground motion can be computed. The computation of ground motion rotations implies the application of the rotational operator to the displacement field. This is done using either numerical derivatives or analytical expressions for the rotational Green tensor. The boundary integral computation requires dealing explicitly with the singularity of Green function.

In this work we present the analytical expressions obtained by the application of the rotational operator to the IBEM's displacement field in 2D and 3D. The contribution of Green function singularity is identified. The obtained expressions are validated using the exact analytical solution for two triangular wedge-like mountains with internal angles of 120º and 90º. Thus, displacements and rotations obtained using the analytical solution are compared with those from IBEM. Additional verifications have been made using the MFS.

Rotations are computed for different topographical configurations and incoming fields in both frequency and time domains. The effects of topography on rotational ground motion are discussed with emphasis on structural response.