Numerical modelling of wave propagation in irregular soil

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Waves propagate in soil due to various actions such as earthquakes, blasting of rocks, or traffic. To understand the behaviour and effects of waves in the soil numerical modelling is required. In general, the earth is an irregular structure consisting of various soil and rock layers with different material parameters. At the same time, topological features such as fissures and faults, voids or aquatic layers can also be present. These irregularities should be addressed and modelled accurately. This is not an easy task as there are several other challenges to overcome such as accurately modelling radiation damping in unbounded domains, or developing efficient solution algorithms for the large-scale problem at hand. Moreover, to create accurate, well-balanced meshes of irregular soil deposits requires experience and can be labour intensive. In this study, the Scaled Boundary Finite Element Method (SBFEM) is used to model wave propagation in the soil in combination with a quadtree meshing approach. The SBFEM is a versatile semi-analytical method which has the capability of addressing all the challenges mentioned earlier. Quadtree segmentation is a very powerful tool for automatic mesh generation. Here, the scaled boundary finite element method overcomes the ubiquitous hanging nodes problem. A displacement unit-impulse response-based formulation of the scaled boundary finite element method is used to model the unbounded domain. Several numerical examples addressing wave propagation in soil with topological irregularities are presented to illustrate the proposed approach.