APCOM & ISCM
11-14th December, 2013, Singapore

The Scaled Boundary Finite Element Method in the Time Domain – Recent Advances

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The scaled boundary finite element method is a semi-analytical technique which has originally been derived in the frequency domain. This paper summarizes recent advances which facilitate the use of the scaled boundary finite element method in time-domain analyses. Both improvements of the original approach based on unit-impulse response functions and novel strategies based on continued-fraction expansions of the dynamic stiffness are addressed. These concepts are of particular importance when modeling wave propagation in unbounded domains. Improved continued-fraction solutions, however, can also be used to model transient phenomena in bounded domains with high accuracy and efficiency. In combination with polygon and quadtree meshes the proposed concepts have the potential to be applied to numerous time-dependent physical problems, including waves in heterogeneous structures and in large-scale geological regions. Applications from elastodynamics, acoustics and transient diffusion will be used as examples to illustrate this.

Keywords: Scaled boundary finite element method, Time domain, Continued fractions, Unit-Impulse response, Quadtree mesh