

Consolidation analysis of saturated soils using edge-based smoothed point interpolation method

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Abstract

In this paper, an advanced fully coupled meshfree algorithm is proposed for numerical analysis of Biot's formulation. Spatial discretisation of the governing equations is presented using the Edge-based Smoothed Point Interpolation Method (ESPIM). In this method, displacement field is constructed using the point interpolation method (polynomial PIM or radial PIM), and therefore the shape functions possess the Kronecker delta property, resulting in easy implementation of the Dirichlet boundary conditions. As opposed to the conventional Finite Element Method (FEM), the Strain field is also construed through smoothing operation over smoothing domains associated with edges of the triangular background cells. Besides, a new technique is employed to construct the coupling matrix and also the compressibility matrix of the model. A three-point time discretisation scheme with second order accuracy along with the generalized smoothed Galerkin weak form is adopted to create the discretised system equations. Application of the model is demonstrated using several numerical examples with analytical or semi-analytical solutions showing its efficiency and accuracy compared to the conventional FEM model.

Keywords: Meshfree method, Smoothed point interpolation method, Porous media, Biot's consolidation