ICPDF '23 – WAVE PROPAGATION ON FULLY SATURATED ANISOTROPIC POROUS MEDIA: A NUMERICAL STUDY

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ABSTRACT- Knowledge of the seismic waves propagation in soils and rocks is constantly improving due to continuous research work in this field by civil engineers and geophysicists. Understanding this phenomenon allows to predict volcanic eruptions, earthquakes and deduce the destructive forces acting on building, to identify material properties of the medium and infer crack distributions and orientations or to detect water, oil and gas reservoirs in the Earth's crust. In order to provide a useful tool for the representation of waves propagation in soils, a fully coupled multi-field model for the dynamic simulation of anisotropic porous materials was developed.
The mathematical model is based on the mixture theory and the definition of the effective stress for anisotropic poro-elasticity, together with generalized Darcy's law for the fluid phase. Through the Galerkin method, the discrete multi-field formulation of the dynamic partial differential equations was developed [1]. The numerical solution of the initial-boundary value coupled problem in space was obtained by using the well-known Finite Element Method (FEM) with inf-sup stable discretizations while, for temporal integration, the generalized θ-method. The Bi-Conjugate Gradient Stabilized (Bi-CGStab) algorithm was used to solve the time-sequence of large sparse non-symmetric linear systems, with convergence accelerated by a suitable preconditioning technique [2], and was implemented in the three-dimensional finite element research code GeoMatFem.
A series of analyses were conducted to validate the model, prove the effectiveness of the results and test the computational efficiency of the solver. Finally, the triggering and spreading of pressure and shear waves in a fully saturated anisotropic soil, developing from a point source of dynamic loading, were investigated.

REFERENCE:

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