BIOT WAVE IN SATURATED POROUS MEDIA

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Seismic wave propagation always becomes an interesting study for scientist, especially for geophysicists.

The wide study to learn, develop, and use seismic waves enables the present scientists or students to acknowledge more information both earthquake and seismic exploration for petroleum, natural gases, mineral deposits, engineering field and so forth. The technique is based on determinations of the time interval that elapses between the initiation of a elastic wave at a selected shop point and the arrival of reflected or refracted impulses at one or more seismic detectors.

The project goal was to make a simulation of Biot wave propagation.

We present a study of Biot wave which is propagating in a poroelastic medium on the structure of fault and sand lens which is saturated by fluid. Theory of elastic wave propagation in a fluid-saturated porous solid medium is first formulated by Biot (1956a). This study could be done by making preliminary programs to calculate the Biot wave equation by finite-difference approach. Such programs, then, will be used to make a simulation of the structure model. Next, we can find the influence of Biot wave propagation from snapshots and synthetic seismograms. This study is useful to test the geology model and the complex stratigraphy by making a parameter variety of reservoir like density, porosity, permeability, and viscosity.

Biot elastic waves (Stoll, 1977)

$$\nabla^2(He - C\xi) = \frac{\partial^2}{\partial t^2}(\rho e - \rho_f \xi)$$
$$\nabla^2(Ce - M\xi) = \frac{\partial^2}{\partial t^2}(\rho_f e - m_k \xi)$$

Solution of Biot equation → a couple of dilatational wave type which creep in poroelastic medium of saturated by fluid which can be expressed into the following form matrix

$$\nabla^2 \begin{bmatrix} e \\ \varepsilon \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} \ddot{e} \\ \ddot{\varepsilon} \end{bmatrix} + \begin{bmatrix} b_1 & -b_1 \\ -b_2 & b_2 \end{bmatrix} \begin{bmatrix} \dot{e} \\ \dot{\varepsilon} \end{bmatrix}$$

Equation of wave dilatation using cantered finite-difference approach is expressed by

$$e(m,n,l+1) = \frac{A_{22}B_1 - A_{12}B_2}{d_2}$$

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RESULTS

Sandstone Homogenous Model and Fault Structure Model