HW#9

Assigned: Thursday, October 22, 2009

Due: Thursday, November 5, 2009

For this homework, write out the fully implicit finite difference expansion required to solve for the dual porosity flow in a two-phase water-oil 1-D system. Note that for the term project, you will need to write the same formulation for a 2-D system. Solve the matrix flow equation for P_{om}^{n+1}. Substitute this into the fracture equation, so the only variable it contains at $n+1$ is P_{of}^{n+1}. Collect terms for the new fracture equation for $P_{of,i}^{n+1}$, $P_{of,i+1}^{n+1}$, $P_{of,i-1}^{n+1}$, with everything else moved to the right hand side. Collect terms for the matrix flow equation for $P_{om,i}^{n+1}$, $P_{om,i+1}^{n+1}$, $P_{om,i-1}^{n+1}$, with everything else moved to the right hand side.

Equations:

- Fracture:

$$\nabla\cdot\left(k_{f,eff}\left(\lambda_{Tf}^{n}\nabla P_{of}^{n+1}-\left(\lambda_{wf}^{n}\gamma_{w}^{n}+\lambda_{of}^{n}\gamma_{o}^{n}\right)\nabla D-\lambda_{wf}^{n}\nabla P_{cwo}^{n}\right)\right)-\tau_{T}^{n+1}+\hat{q}_{Tf}=\phi_{f}C_{Tf}\frac{P_{of}^{n+1}-P_{of}^{n}}{\Delta t}$$

- Transfer:

$$\tau_{T}^{n+1}=\sigma k_{m}\left(\lambda_{Tf}^{n}(P_{of}^{n+1}-P_{om}^{n+1})+\frac{\sigma_{z}}{\sigma}(\lambda_{wf/m}^{n}\gamma_{w}^{n}+\lambda_{om/f}^{n}\gamma_{o}^{n})(h_{wf}^{n}-h_{wm}^{n})+\lambda_{wf/m}^{n}(P_{cwom}^{n}-P_{cwof}^{n})\right)$$

- Matrix flow: $\tau_{T}^{n+1}=\phi_{m}C_{Tm}\frac{P_{om}^{n+1}-P_{om}^{n}}{\Delta t}$