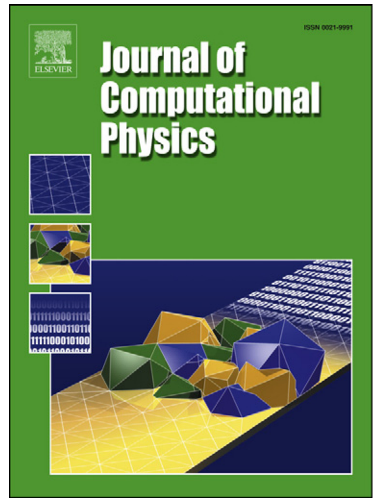

A quasi steady state method for solving transient Darcy flow in complex $3D$ fractured networks accounting for matrix to fracture flow

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Modeling natural Discrete Fracture Networks (DFN) receives more and more attention in applied geosciences, from oil and gas industry, to geothermal recovery and aquifer management. The fractures may be either natural, or artificial in case of well stimulation. Accounting for the flow inside the fracture network, and accounting for the transfers between the matrix and the fractures, with the same level of accuracy is an important issue for calibrating the wells architecture and for setting up optimal resources recovery strategies. Recently, we proposed an original method allowing to model transient pressure diffusion in the fracture network only [1]. The matrix was assumed to be impervious. A systematic approximation scheme was built, allowing to model the initial DFN by a set of N unknowns located at each identified intersection between fractures. The higher N, the higher the accuracy of the model. The main assumption was using a quasi steady state hypothesis, that states that the characteristic diffusion time over one single fracture is negligible compared with the characteristic time of the macroscopic problem, e.g. change of boundary conditions. In that context, the lowest order approximation $N = 1$ has the form of solving a transient problem in a resistor/capacitor network, a so-called pipe network. Its topology is the same as the network of geometrical intersections between fractures.

In this paper, we generalize this approach in order to account for fluxes from matrix to fractures. The quasi steady state hypothesis at the fracture level is still kept. Then, we show that in the case of well separated time scales between matrix and fractures, the preceding model need only to be slightly modified in order to incorporate these fluxes. The additional knowledge of the so called matrix to fracture transfer function allows to modify the mass matrix that becomes a time convolution operator. This is reminiscent of existing space averaged transient dual porosity models.

Keywords: Transport in Fractured media, Fractured Reservoirs, Discrete fracture network, Low permeability matrix, Quasi steady state, Dual porosity, Transfer function, Laplace transform