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Streamline Diffusion Method for Waterflooding in Petroleum Reservoirs Using Diffpack Library

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Mathematical modeling and numerical simulation of petroleum reservoirs play important roles in high costly recovery processes. There are four important stages in the simulation process, first, the principal laws governing the fluid flow process thorough porous media such as Darcy's law, mass conservation, mass transfer and capillary law, have been identified. Secondly mathematical model of problem including differential equations mainly having the form of nonlinear and coupled is obtained. Thirdly after verifying the existence, uniqueness and smoothness of solution with choosing a suitable numerical method obtain the discrete forms of equations. And finally discrete forms of equations solved with a computer program.

Reservoir simulators mainly apply the Finite Difference Method (FDM). With recent achievements in obtaining physical properties of reservoir geometries and geology this seems reasonable that we looking for advanced numerical methods such as Finite Element Methods (FEM) having the ability of high order approximation.

FDMs that based on discretization of derivatives that appear in equations. On the contrary FEMs based on integration of weak forms of equations.

The novelties of this work are: 1.Presentation an advanced method from Finite Element Class named SUPG (Streamline (Upwind) Petrov Galerkin) and 2.implementation in the way of object oriented programming, using Diffpack Library.

In this work we choose Waterflooding process, one of the EOR processes for increasing petroleum reservoirs recovery. The mathematical model of this process is a two-phase incompressible immiscible fluid flow model. (Water and Oil)

And finally in the implementation stage we use Diffpack library, an object oriented library for the numerical solution of partial differential equations.