General Instructions

Type *run Main.m* in the MATLAB command window to run the program. It will ask for the some data which should be entered correctly.You can enter any number of injectors or producers using this program.

P- Pressure matrix

TOF- total time of flight

stx- streamline X-co-ordinates

sty- streamline y-co-ordinates

qx,qy- rates at cell interfaces(scf/day)

The above variables in the *datafiles.mat* file which can loaded into MATLAB.

Pressure Solver

Pressure is solved by discretizing the steady state pressure equation. Transmissibilities are calculated for x and y direction at cell interfaces using the usual averaging techniques. The transmissibility matrix has 5 diagonals. Each diagonal has been constructed separately in my program using a specific algorithm. The diagonals are then added up to construct the transmissibility matrix. The matrix on the RHS consists of rate and Peaceman's constant times pressure terms. This matrix is populated based on the prior information collected from the user about the location of wells and whether it's rate or pressure constrained. The transmissibilties on the sides are zero due to no flow boundaries. The pressure matrix of the form TP=D is solved to get Pressure at various gridpoints.

Streamline Tracing

Darcy's law is used to generate the rates at cell interfaces. Then I work in dimensionless co-ordinates to generate the streamlines based upon pollock's algorithms. The streamline is started from 4 points each on 2 adjacent sides of the block containing the producer. The streamline is traced back to the producer based on trajectory and time of flight calculations.

$$\alpha = \alpha_0 + (Q_{11} + \delta Q_1 \cdot \alpha_0)\left(\frac{Exp(\delta Q_1 T) - 1}{\delta Q_1}\right)$$

$$\beta = \beta_0 + (Q_{21} + \delta Q_2 \cdot \beta_0)\left(\frac{Exp(\delta Q_2 T) - 1}{\delta Q_2}\right)$$

Time of flight

Time of flight is calculated for all the four faces using the below equations. If the argument inside the ln is negative then it means that the streamline doesn't come out of that face. It is approximated by a high TOF in my program. The program calculates the minimum positive time and then calculates the trajectory based on this. The streamline jumps from one cell to another and accordingly cell indices ,α,β are updated. The same loop is run till the streamline hits a boundary,well or stagnation point.

$$t = \left(\frac{1}{\delta Q_1}\right) Ln\left[\frac{Q_{11} + \delta Q_1 \cdot \alpha}{Q_{10}}\right] \quad Or, \quad t = \left(\frac{1}{\delta Q_2}\right) Ln\left[\frac{Q_{21} + \delta Q_2 \cdot \beta}{u_{20}}\right]$$

$$Q_{10} = Q_{11} + \delta Q_1 \cdot \alpha_0 \qquad Q_{20} = Q_{21} + \delta Q_2 \cdot \beta_0$$

Problem Definition

The grid is of size 22 x 22

Nx=22

Ny=22

Dx=100 ft

Dy=100 ft

Dz=1 ft

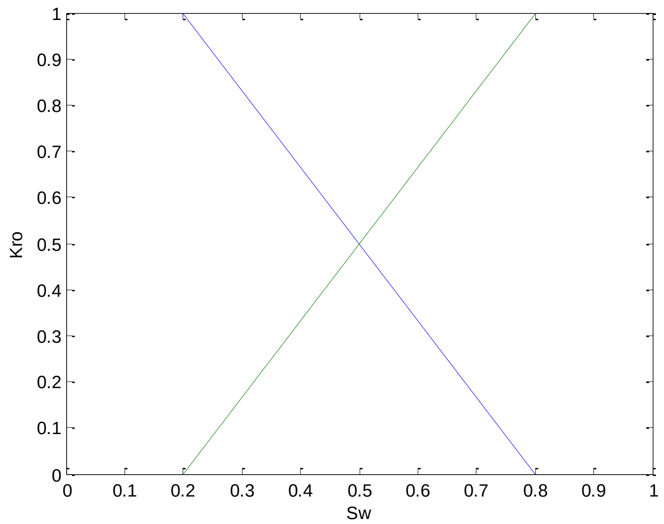
Ø=0.21

$K_x = 100\ md$

$K_y = 100\ md$

Relative Permeability is described by the below Corey type Rel-Perms.

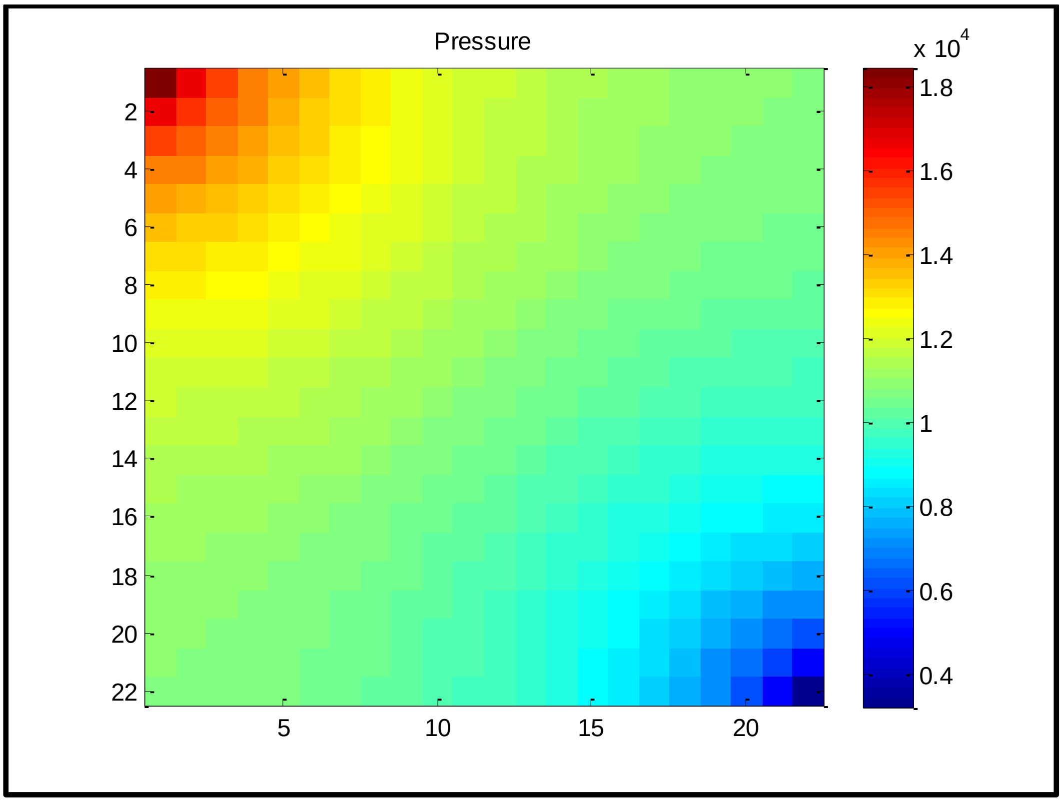
Sw is assumed to be 0.2 for all cells



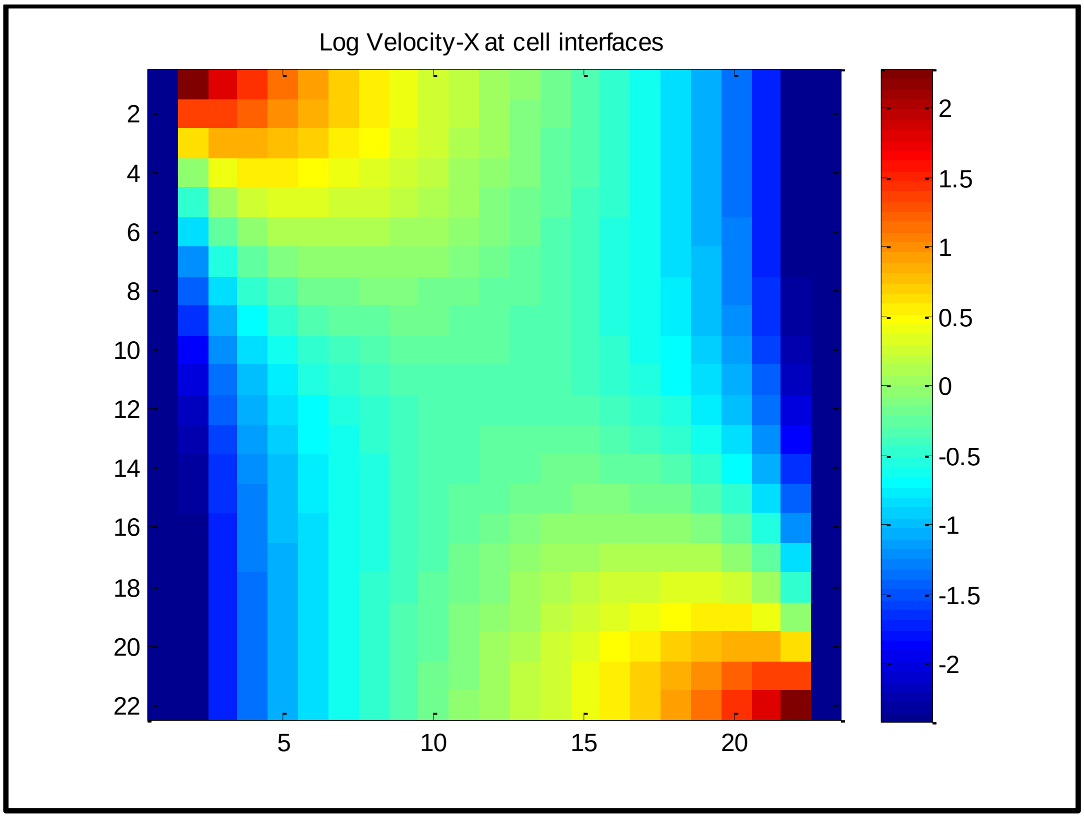
Injector is located in (1,1) and is injecting at 350 stb/day

Producer is located in (22,22) and is producing at a pressure constraint of 1000psi. The wellbore radius of the producer is assumed to be 0.5 ft.

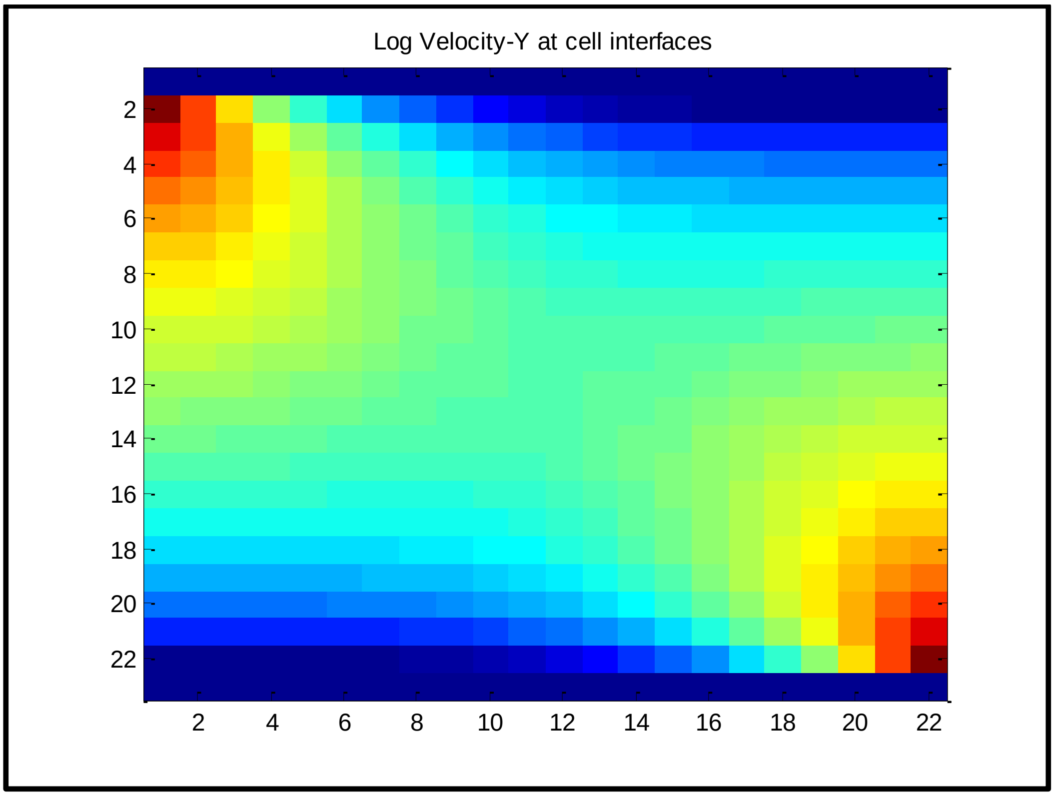
Pressure



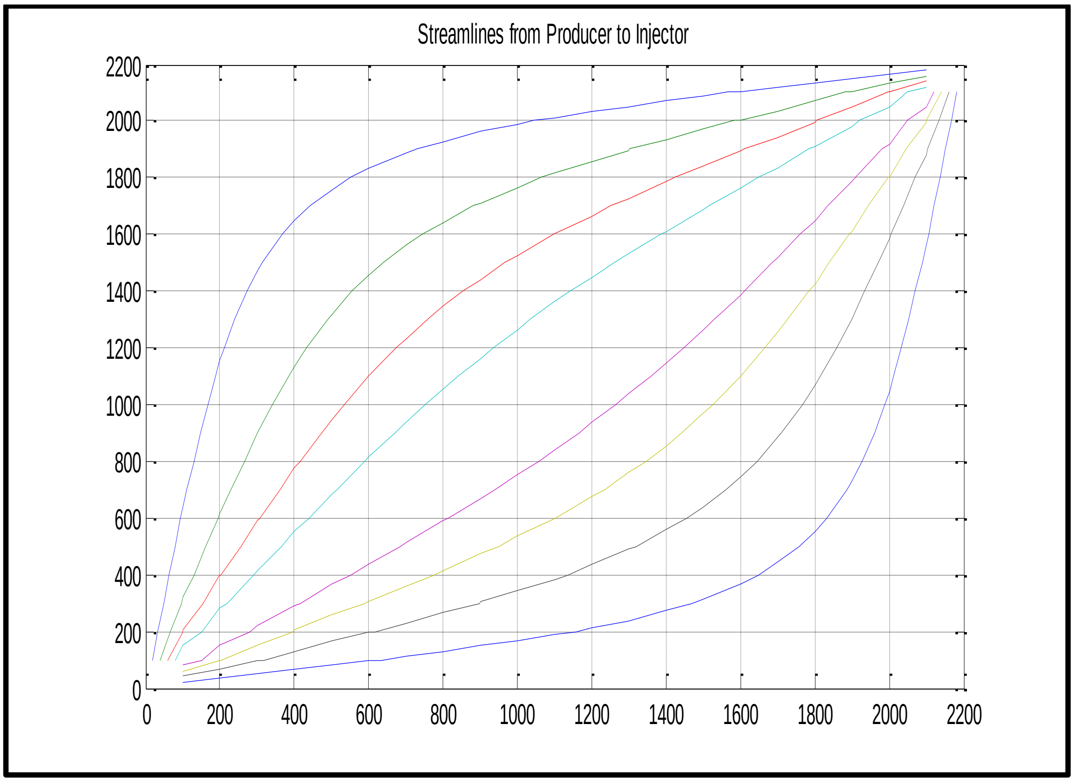
Velocity-X



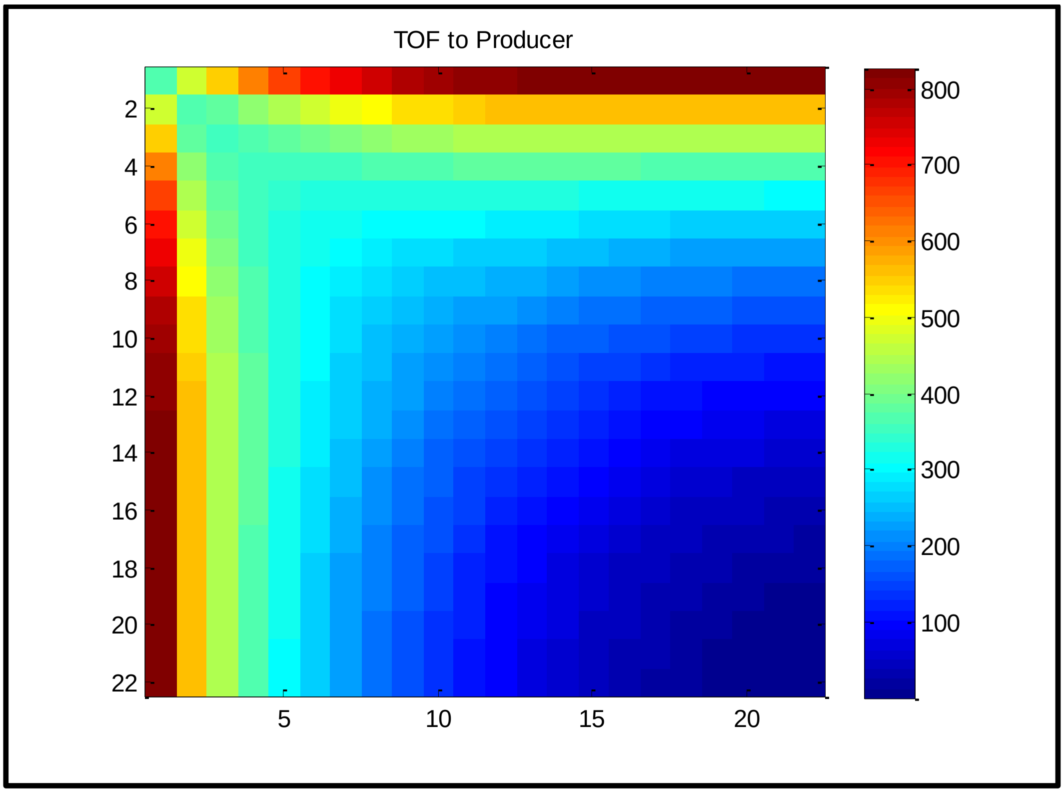
Velocity-Y

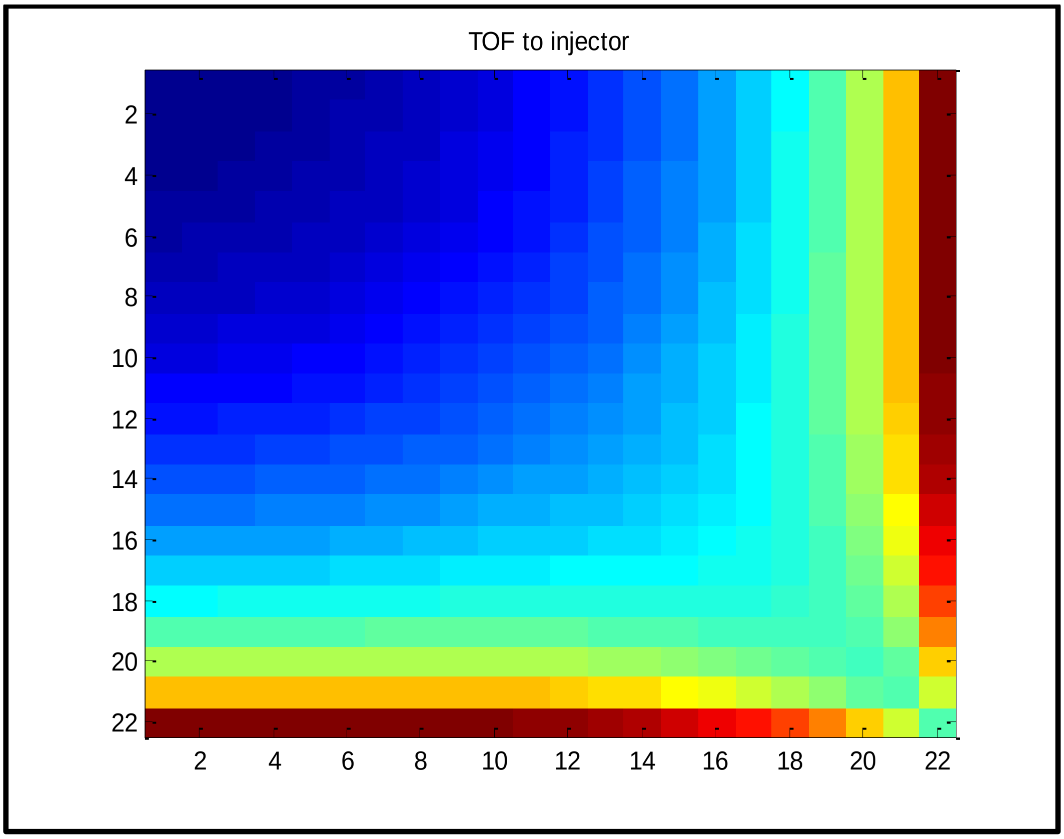


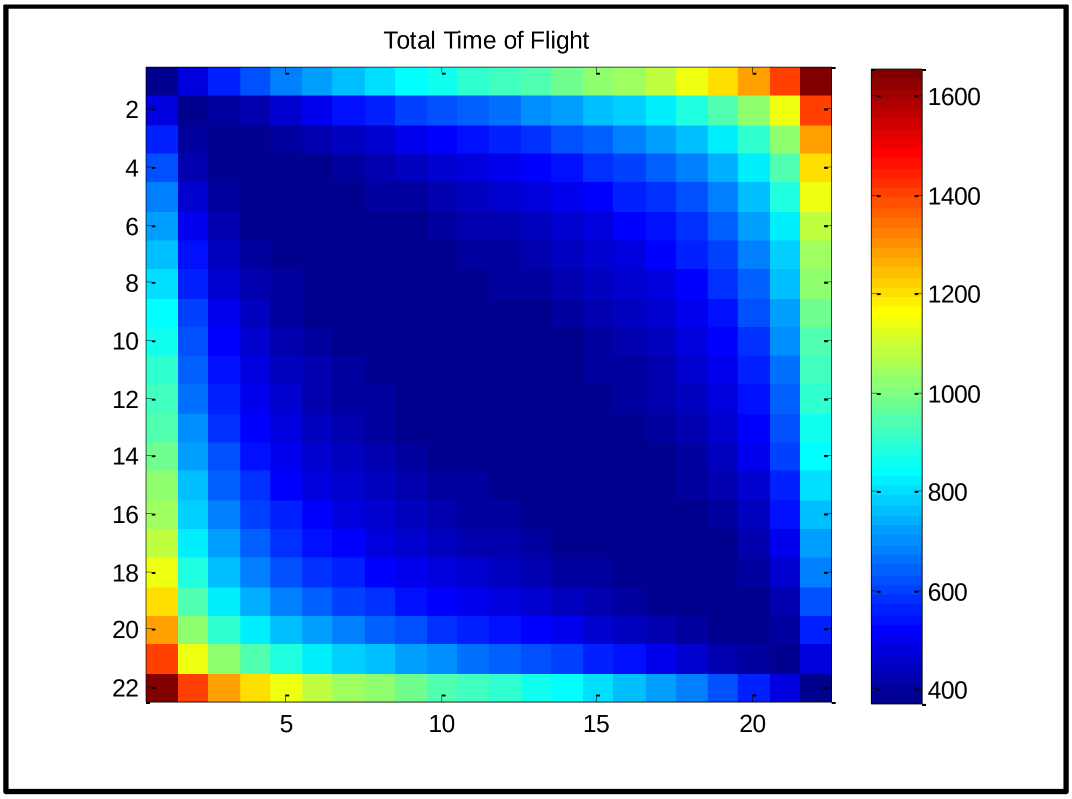
Streamlines



Time of Flights







Total Time of Flight
2
4
6
8
10
12
14
16
18
20
22
5
10
15
20
1600
1400
1200
1000
800
600
400