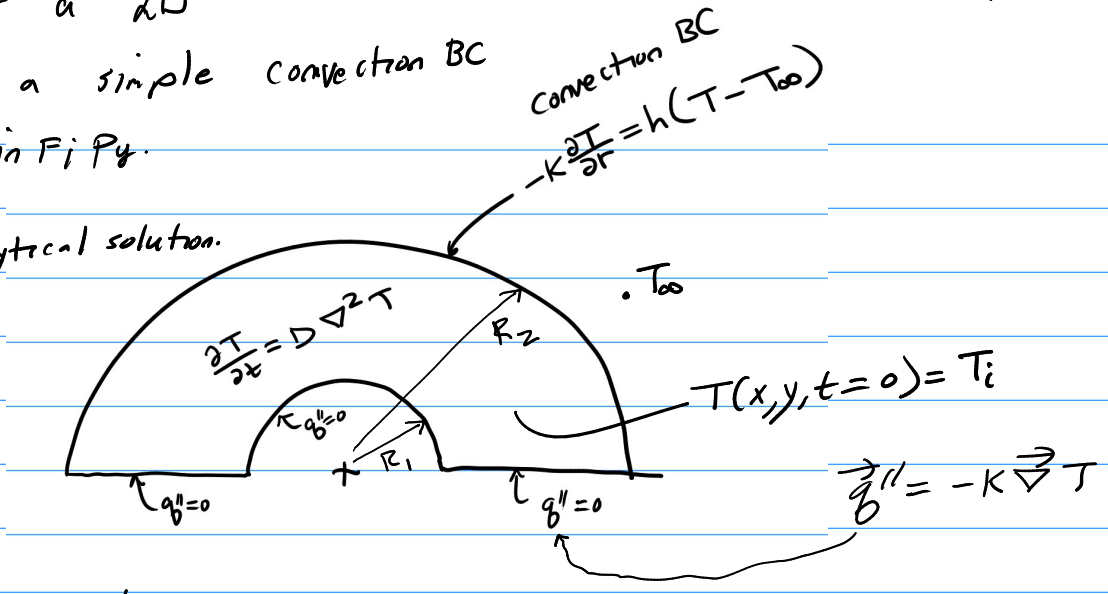
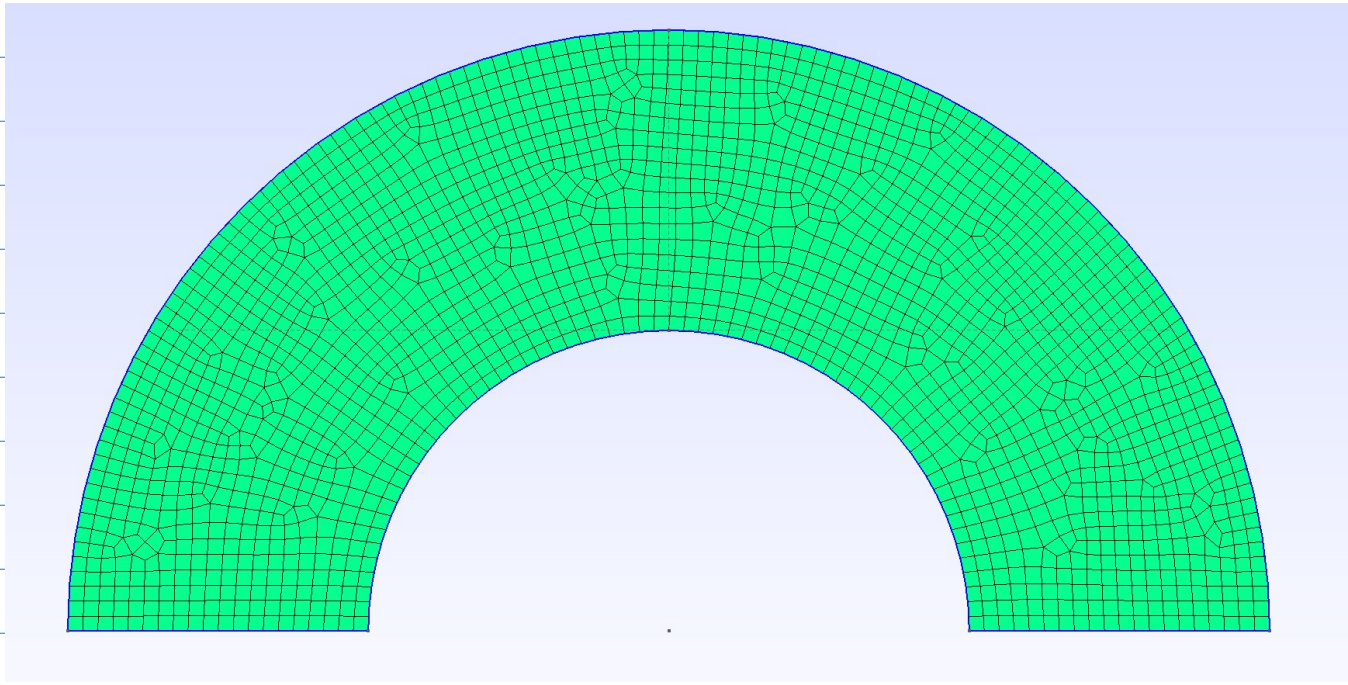
Attempt a 2D heat conduction problem for the purpose of getting a simple convection BC to work in FiPy.

Compare to analytical solution.



initial gmsh mesh:



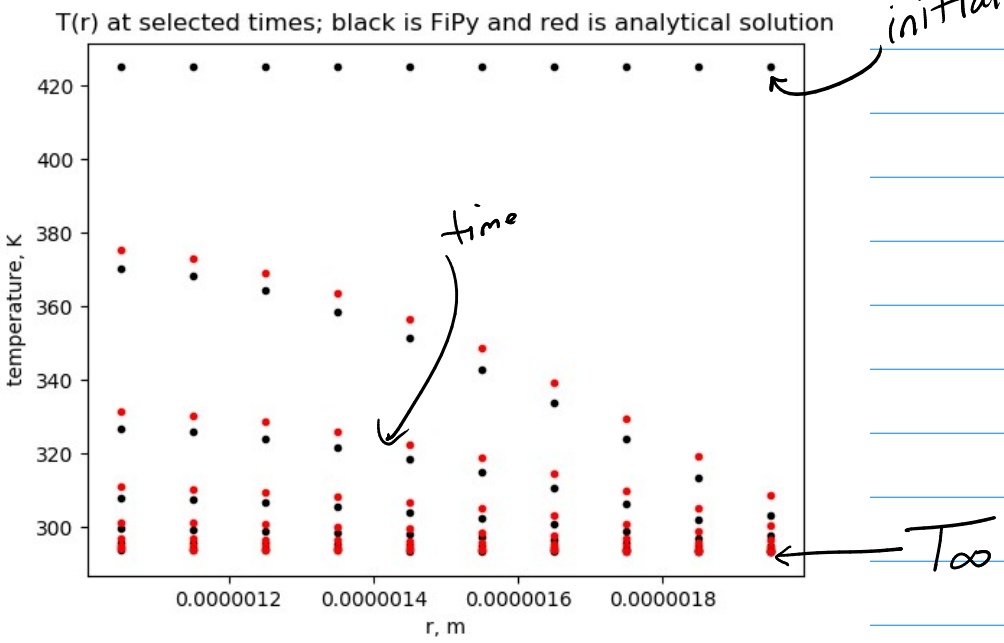
$R_1 = 1e{-}6\ m$ $\quad R_2 = 2e{-}6\ m$ $\quad \frac{cell\ size}{R_2 - R_1} = .05$

$$Biot\ \# = \frac{h\ R_1}{K} = 10.0$$

$$dt\_explicit = \frac{cellSize^2}{2\ D}$$

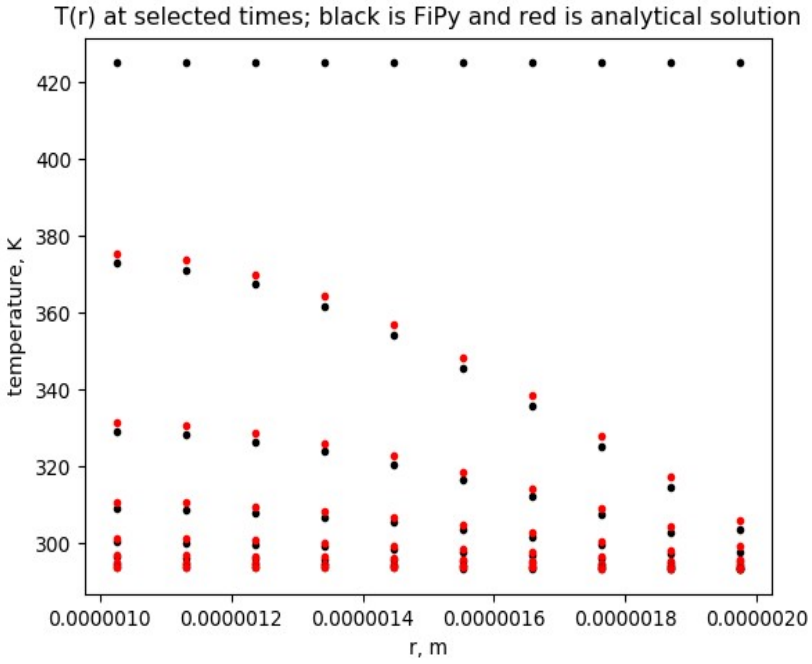
$$dt = .9 * dt\_explicit$$

First mesh:

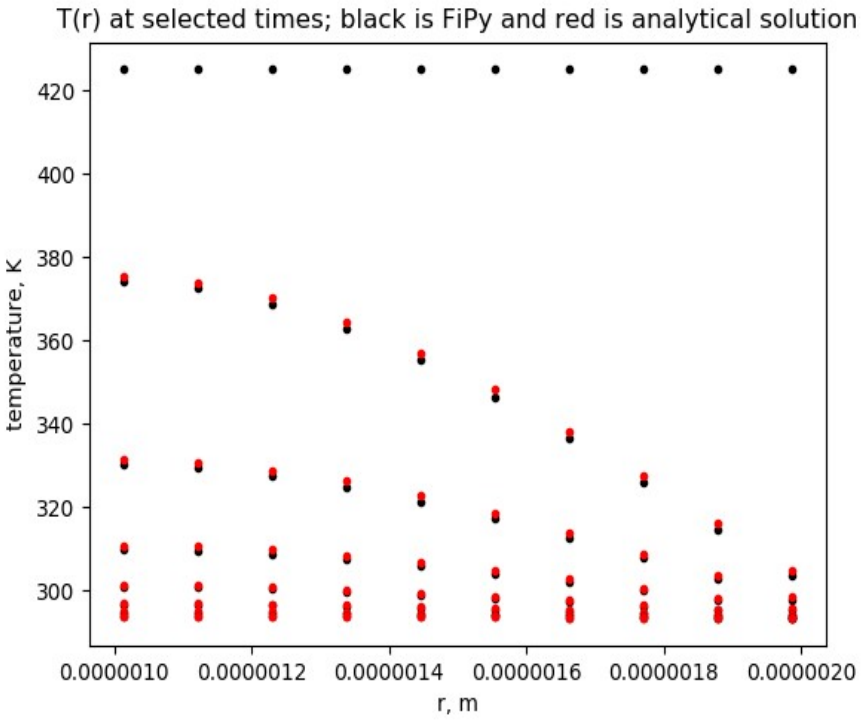


final time ~ $t' = 2$ where $t' = \frac{t \cdot D}{R_1^2}$

2nd mesh: divide cell size in half



3rd mesh: again cut cell size in half:



Seems like FiPy solution is converging to analytical solution.

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1. Problem description

This problem is for a homogeneous annulus of inner radius R_1 and the outer radius R_2. It is subjected to heating through convection with an environment temperature T_∞. The inner surface is insulated. At time t=0 temperature at every point inside the cylinder is 0.

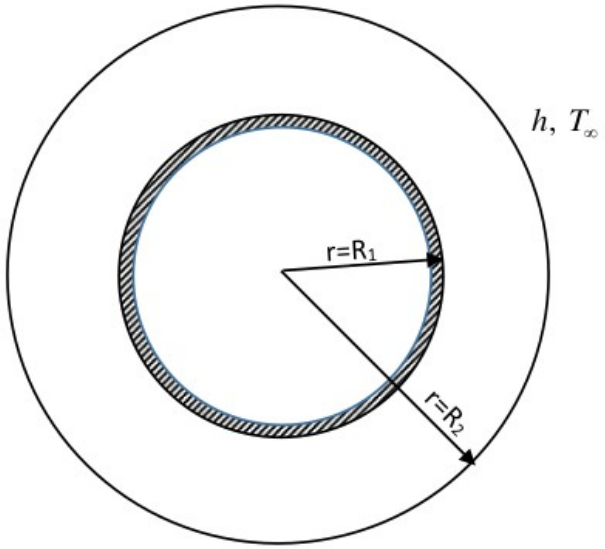

Figure 1. Schematic of R23B10T0 problem

Source of analytical solution in the form of mfiles for Matlab/Octave