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ISC 4304C

HOMEWORK ONE – scientific programming in excel

In this lab we are to implement the usage of the implicit finite differential method to solve a one dimensional transient state heat equation.

1. Equation’s used: 1. Hni = (-Beta \* Hni-1 – Hn+1i – Hn-1i ) / -Alpha

Hni = (-Beta \* Hni-1 –(2Hn-1i )) / -Alpha

2. I implemented the finite differential equation by implementing the Neuman method since only the left hand boundary is provided and the right hand is not. By implementing Neumans method we are able to approximate the value of the missing right boundary with the use of the 2nd equation. The original PDE equation before being algebraically modified is:

HDELTA Tn+1 - Alpha\*HDELTA Tn + HDELTA Tn-1 = -Beta\* H0n

Where

Alpha = (2 + S\*delta Y2 )/ (T \* delta T)

Beta = (S\* Delta Y2 )/ (T \* delta T)

when calculating the right hand boundary cells H5 the Neuman method uses the ghost cell approach. The ghost cell approach is a mathematical theory that states that the H4 cell is equal to a theoretical H6 cell, by then applying the 1st equation above to the H5 cell it resulted in subtracting by the cell H4 twice. The initial conditions are used in the equations when trying to find the values of the first timestamp of H1 to H5 in the cells. The initial values are implemented in the final equation where it is multiplied by Beta. The scheme is implemented by setting every cell up to the final time stamp and through H1 to H5, a final answer cannot be found until all cells are run through with the same equation.

3. my results were found through the use of the Neuman method since the one-dimensional cubic cell space is given only one boundary in this lab. What this PDE is computing is the transfer of heat or some substance through a one dimensional confined aquifer with homogeneous and isotropic hydraulic conductivity. The domain also contains a constant initial head over the domain. By discretizing the heat equation through a 3 dimensional cell in space and time we are able to develop a finite difference equation, this equation is then derived into an implicit/explicit form. The explicit difference is simple, but only conditional stable; implicit difference is more complicated, but unconditional stable. Using simple algebra the formula is then able to be turned into a form capable of solving an unknown variable. The reasoning behind the derivation of the formulas is to find the difference between the mass in the cells and measure the inflow vs. outflow of the substance traveling throughout the domain.