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ISC 4304C

LAB 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 used: Hni = (-Beta \* Hni-1 – Hn+1i – Hn-1i ) / -Alpha

2. I implemented the finite differential equation by using the Dirichlet method since boundaries are provided. The boundary conditions in this case are implemented through the H1 and H5 cells known as the left boundary and right boundary respectfully. These boundaries are required in order to implement the formula used above. 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 first time stamp for H2 and H4 using the Dirichlet method, both the left and right boundary values are required in order to solve for HN.

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 Dirichlet method since the one-dimensional cubic cell space is given boundaries 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.