

ENGR 1213 Project

Numerical Approx. of Steady-State Temp Distribution in Flat Plate

Requirements

1. Write a C computer code that calculates the steady state temp. distribution in a flat plate with temperatures specified on all four boundaries. The code will be written by your team.
 1. Your code must take input, the length and width of the plate, the grid size in Fig. 1 and the boundary temperatures in degrees C. The input may be entered from the keyboard, but should perform any error checking on the entered data.
 2. Your code will need to set up the “nodes” as shown in Fig. 1. The boundary will be needed for the next steps, so you will need to consider the boundary temps. here in some way.
 3. Your code will need to have a way to set up the *temperature coefficient matrix (A) and the right hand side matrix (b)* as in the matrix equation: $Ax = b$. This will be discussed in class.
 4. Your code will need to have an algorithm to find the temperatures from the the matrix equation discussed in item 3. Note the temp. of node i in Fig. 2 can be found as the average of the surrounding temperatures shown: $T_i = (T_n + T_e + T_s + T_w) / 4$
 5. Your code will need to have a means of outputting results. This might be graphical, or otherwise easy to use to be able to see the temperature distribution in the plate.

2. Test the computer code with a known test case. This case may come from a textbook or the web (but should be properly referenced).
 1. Part of this test should be the effect a grid resolution study where you methodically change the grid size (increase/decrease) and the temperature distribution is shown to approach the known solution.

3. Test the computer code with a a problem for which you do not know the solution. In this case any problem is OK to pick, but it is best that you have a means of making sure the results are reasonable.

4. Documentation (Each three person group will need to submit a group report and each person in each group will submit an individual report on their work. The individual report will be due on Dec. 3, 2008 by 11:59 p.m., the group report will be due on Dec. 5 at 11:59 p.m.).

(See http://evan.lemley.org/courses/engr4123_fall_2008/report_template.doc for a report template, and http://www.asme.org/Publications/ConfProceedings/Author/Formatting_Paper.cfm for paper formatting)

The reports should be made into pdfs (<http://www.primopdf.com/>) before e-mailing them. The e-mail address to e-mail to is: elemley@gmail.com.

1. Introduction – the basics of the problem and why approximate solutions are of interest. Why are you doing this problem.
2. Background – this should include relevant background theory.
3. Problem Description – What problem are you tasked with solving (graphics are nice)
4. Solution Methodology
 1. Algorithm Flow Chart - basic flow of the program – not all of the details.
 2. Source Code - A listing of the source code.
 3. Sample Input - The input may be performed by an input file, interaction with the user etc... you must show a sample of it.
5. Results and Conclusions
 1. Test Cases – These are described in numbers 2 & 3 above.
 1. Define the test case (a Figure would be nice). If a solution is known or has been estimated this should be shown either in equation form, graphically, or both.
 2. Input and output of the program for the test case.
 3. A comparison of the results to the test case known or estimated solution.
 4. If differences exist with the known or estimated solution, then why? Does grid refinement help?
 2. Error Analysis – What error is associated with the solution. A grid refinement study is required here to see the effects of a finer grid.
5. Presentation (The group will do a short graphical presentation on the last day of class – Dec. 5).

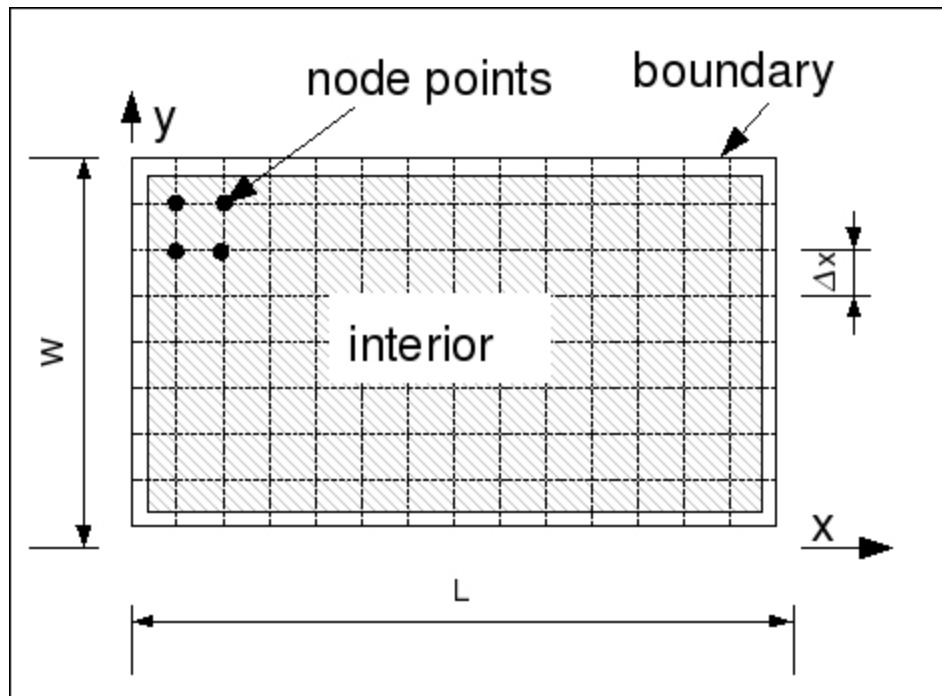


Figure 1: Basic geometry set-up.

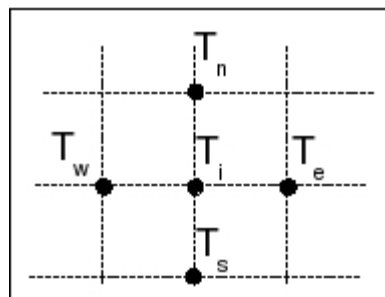


Figure 2: Nodal temperature averaging.