MEEN2250 Dr. Matthew J. Traum
Computer Aided Engineering University of North Texas (UNT)
Spring Semester 2009

Group Project 04:
Flat Plate Temperature Profile Using ANSYS
[25 Points]

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This assignment is to be submitted in hard copy format in class.

Only one submission of each deliverable per team is required.
Associate all team members' names with the report.

Background

In two previous MEEN 2250 homework assignments, you have explored how to plot the spatial temperature profile of a square flat plate held at four different temperatures along its four edges. In Assignment 07, a finite difference approach programmed in MS Excel was used to approximate temperature contours. In Assignment 08, the exact solution for this problem was derived. However, the exact solution includes the sum of an infinite series, and a numerical summation in MATLAB was necessary to obtain an approximation to the exact flat plate temperature profile.

In Group Assignment 04, the same problem will be solved in a third way using a different software package, ANSYS, and another computational engineering approach, finite elements.

For this group assignment, use ANSYS to approximate the spatial temperature profile solution for a plate heated to 200 ºC on the top, 600 ºC on the bottom, 50 ºC on the left, 100 ºC on the right. These temperature boundaries are identical to the conditions given in MEEN 2250 Assignment 07 and Assignment 08.

Deliverable

Numerically solve for the temperature distribution using ANSYS. The number of iterations required will be determined by checking the accuracy of the numerical solution against the results of the analytical solution, which was completed in MEEN 2250 Assignment 08.

Investigate the size of the mesh and the number of iterations required for convergence. Start with a 10X10 element mesh and compare the result to a 50X50 element mesh and a 100X100 element mesh.

For the Numerical results, please present temperature contour diagrams with color-bars and labels on the axes. Juxtapose theses results against one temperature contour diagram representing the exact solution taking the first 100 iterations of the infinite series. The temperature contour diagram for the exact solution was already completed using MATLAB in Assignment 08; it is adequate to copy an existing MATLAB-based contour diagram into this group assignment.

Grading

The following grading rubric items will be applied for this assignment.

A. Geometry and boundary conditions for a heated plat plate are laid out correctly in ANSYS. [3 points]

B. Three ANSYS temperature contour plots are given showing impact of increasing mesh fineness: a 10X10 element mesh [2 points], a 50X50 element mesh [2 points], and a 100X100 element mesh [2 points].

C. It is apparent that finer mesh sizing leads to a more accurate representation of the exact solution. [3 points]

D. On the ANSYS contour plots, an appropriate number of iterations is used to converge to an engineering approximation of the exact solution (i.e., all temperatures are within ± 0.25 ºC of the exact value) [3 points]

E. On the contour plots, chart data color labels and axis labels are numerically correct, of appropriate size, are centered under axes, and do not obscure data. [3 points]

F. On the contour plots, appropriate colors represent each data set. Colors are easily distinguishable and are common shades (i.e., red and blue NOT lavender and mauve). When possible, colors should represent intuitive data trends (i.e., 'hot' temperature data is red while 'cold' temperature data is blue'). [2 points]

G. The brass plate is correctly oriented (i.e., 200 ºC top, 600 ºC bottom, 50 ºC left, 100 ºC right) [2 point].

H. Solution for entire brass plate appears to be correct. Qualitatively, it is hot were it is supposed to be and cool where it is supposed to be [3 point].

Numerical grading of B, F, and G will be assessed based on how well items map to the following scale.

2 – Adequate, 1 – Inadequate, 0 – Nonexistent

Numerical grading of A, C, D, E and H will be assessed based on how well items map to the following scale.

3 – Exceptional, 2 – Adequate, 1 – Inadequate, 0 – Nonexistent

Notes:

1. Each member of the group will share the same grade on this assignment, and group assignments will not be dropped when calculating students' course grades.