Indian Institute of Technology Bombay

Department of Aerospace Engineering

AE706 – Computational Fluid Dynamics

Assignment 3 Report

Report By:
Mayank Bajaj
Roll No.- 210010039

Course Instructor: Prof. J. C. Mandal

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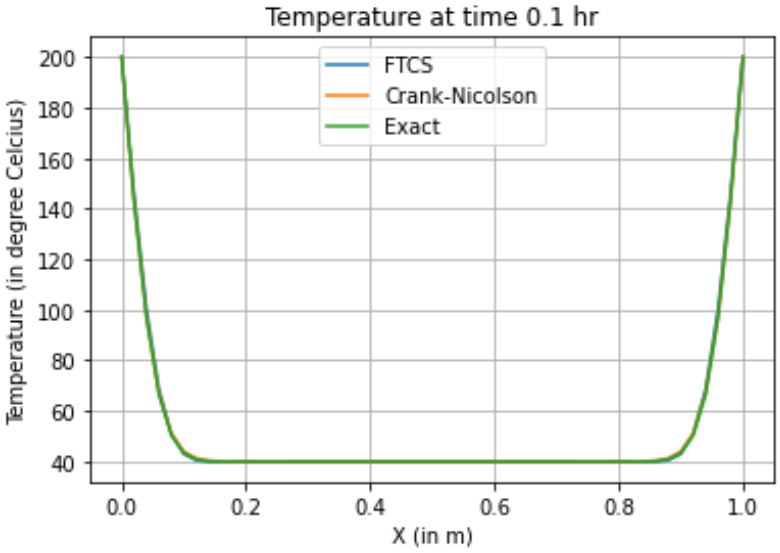
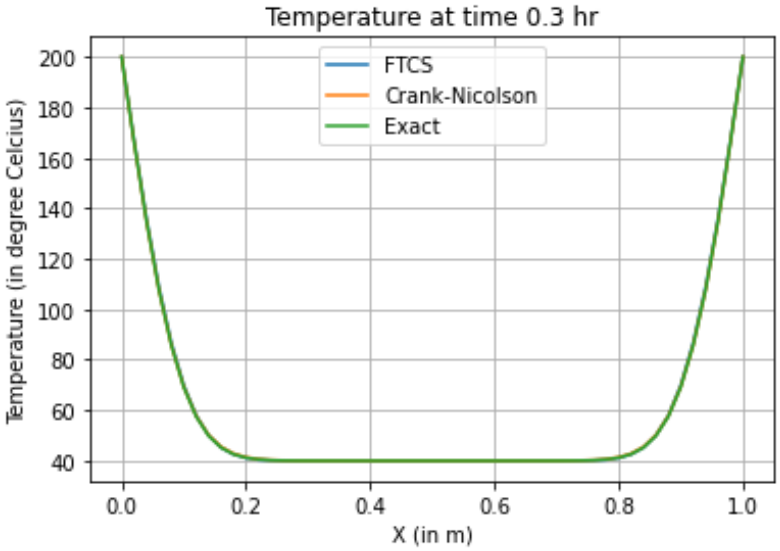
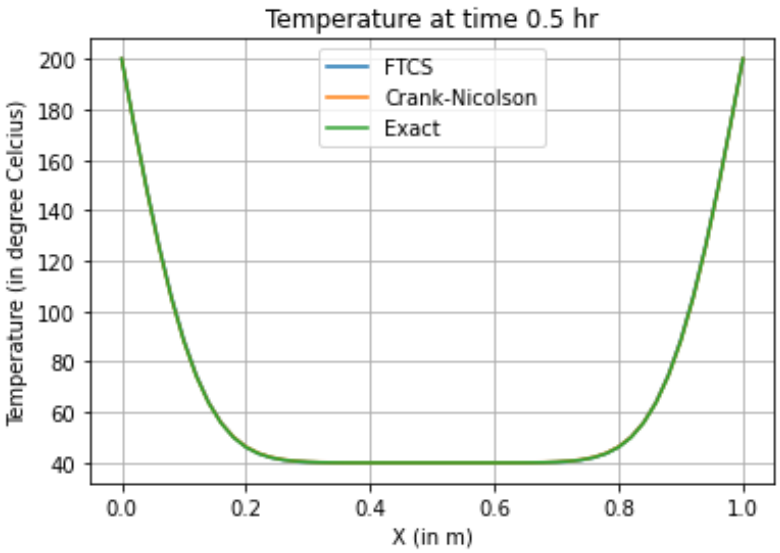
Temperature Plots:



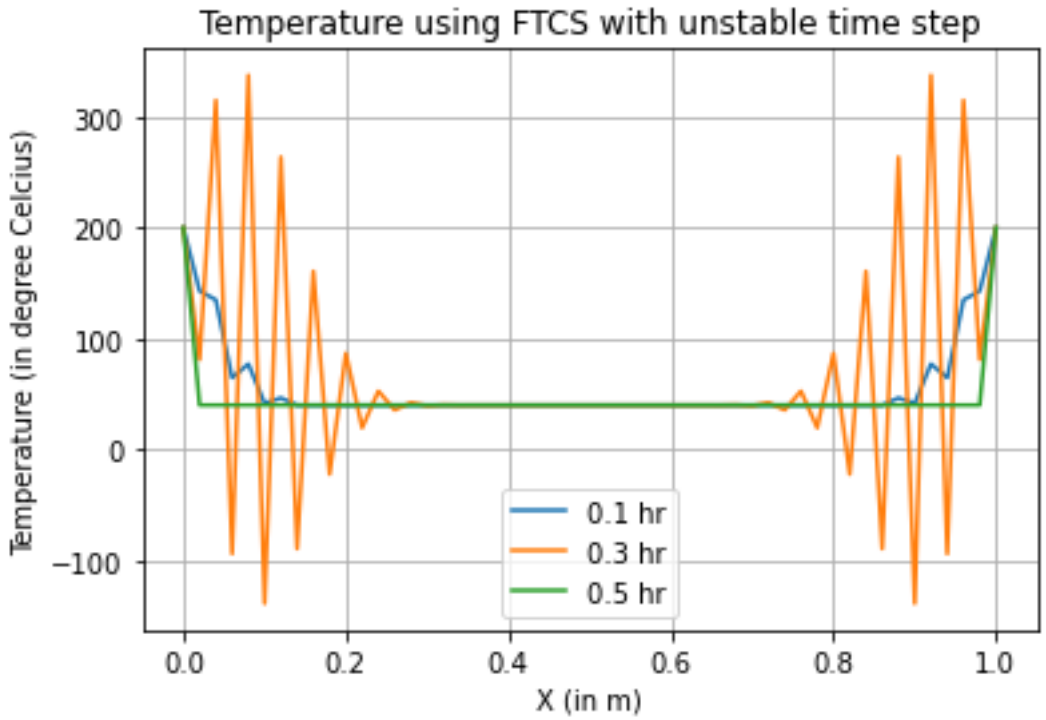




Comments:

We see that the value of Temperature at each time (0.1 hr, 0.3 hr and 0.5 hr) is very close to the exact solution and very difficult to differentiate in the plot. We will see the difference when we plot the error plots. The timestep used in these calculations is 60 seconds which is less than the instability threshold of 78.9 seconds.

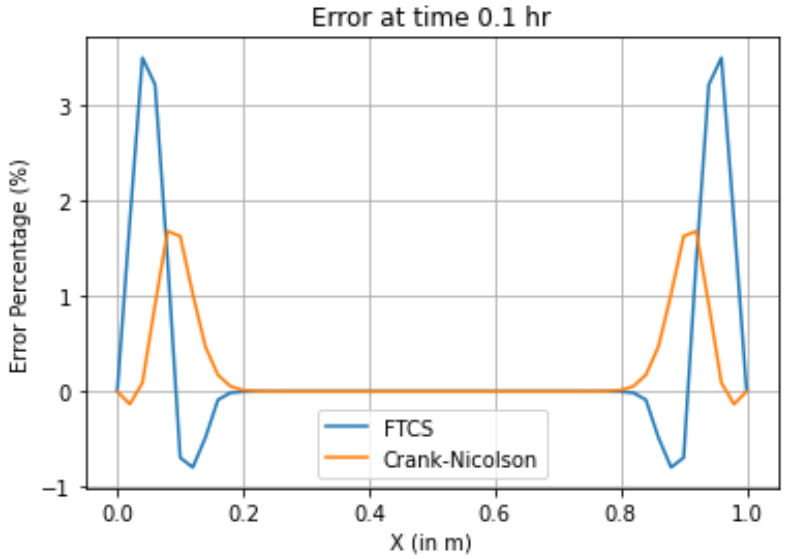
Instability threshold verification

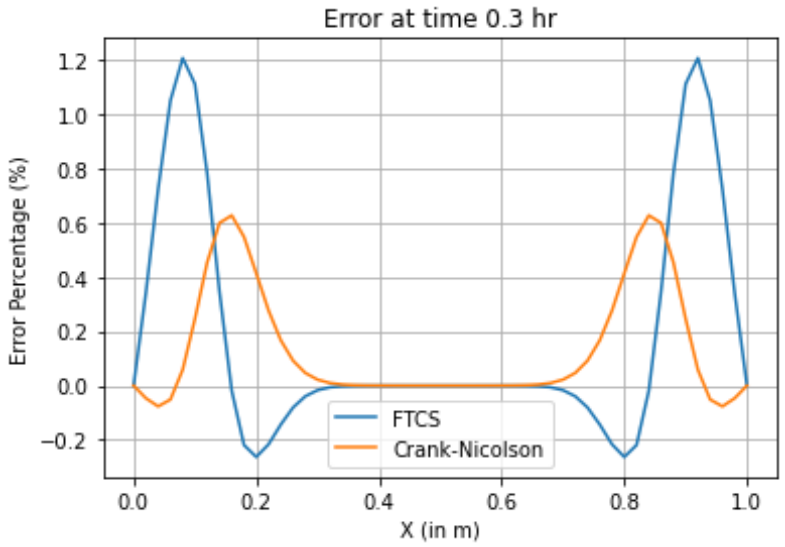


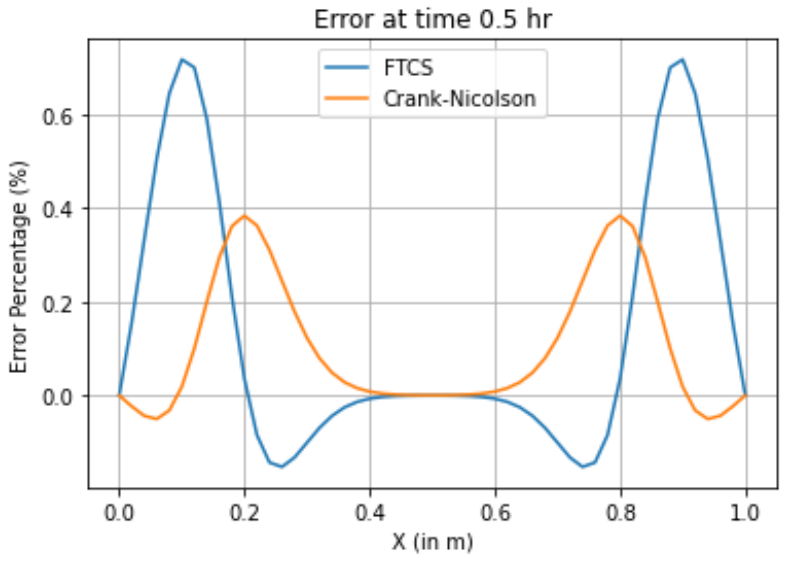
Comments:

We see that when we increase the timestep to 90 seconds which is beyond the instability threshold. The temperature has very high oscillations and goes to the initial temperature after multiple time steps.

Error Plots:


Error at time 0.1 hr
Error Percentage (%)
X (in m)
FTCS
Crank-Nicolson
3
2
1
0
−1
0.0
0.2
0.4
0.6
0.8
1.0


Error at time 0.3 hr
Error Percentage (%)
X (in m)
FTCS
Crank-Nicolson
1.2
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
0.0
0.2
0.4
0.6
0.8
1.0


Error at time 0.5 hr
Error Percentage (%)
X (in m)
FTCS
Crank-Nicolson
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

Comments:

The error percentage decreases as more time has passed. This is observed for both the methods. We also observe that the Crank-Nicolson has significantly more accurate near the wall when compared to the FTCS method whereas the FTCS method seems to be more accurate near the centre.