Steady 2D Diffusion

Computational Fluid Dynamics (AM5630) Assignment 2

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Contents

1 Steps Followed

1.1 Mesh Geometry

Objective : Define the Mesh Geomety

STEP 1 first create a differential 2D Control Volume with

length along x delta_x

length along y delta_y

n required number of such differential control volumes required to construct full CV

STEP 2 Compute the computational nodes for each differential control volume

`src/mesh_geometry.jl`

1.2 Computations

Objectives : COMPUTATIONS

STEP 1 identify the boundary nodes and apply the boundary conditions

Boundary 1 : $T_1 = 15$ Boundary 2 : $T_2 = 10$ Boundary 3 : $T_3 = 5(1\text{-}y/H) + 15 * \sin(pi*y/H)$

STEP 2 write the equation for boundary 4

STEP 3 write the equation for internal nodes

STEP 4 setup the conditons for tolerance Approach :

1. pick n random nodes from grid
2. save temperature before each iteration
3. find the temperature after iteratrion
4. diff = $\text{after}_{\text{iterationtemperature}}$ - $\text{before}_{\text{temperature}}$
5. elementwise square each difference diff.^{2}
6. max(diff.^{2}) $<$ tolerance

and

prepare the required helper function for computation

STEP 5 perform the computations

2 Plots with varying parameter

tolerance is set to 0.00001

delta$_\mathbf{x}$ length of differential cv in x direction

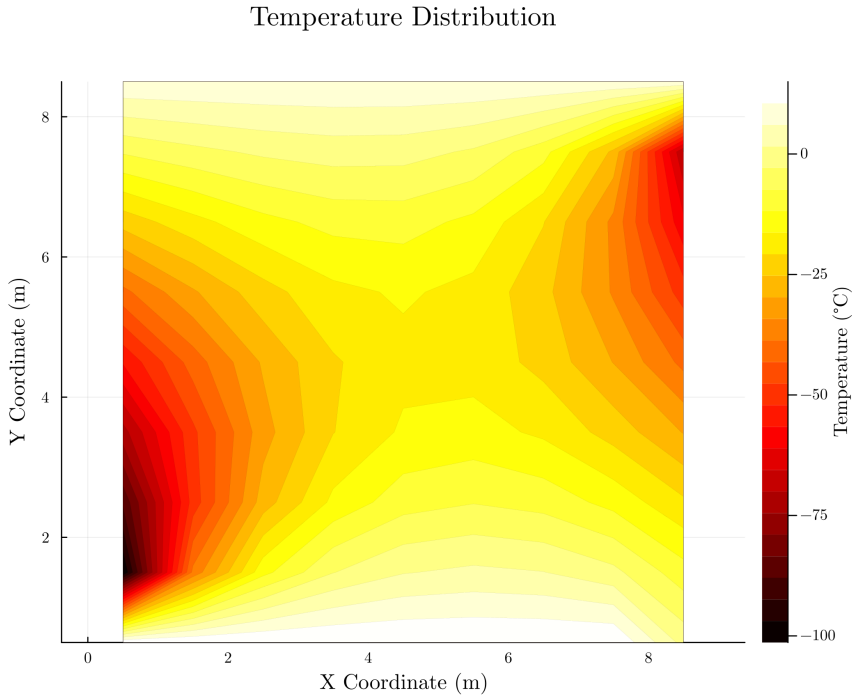
delta$_\mathbf{y}$ length of differential cv in y direction

n number of grids

2.1 Plot with n = 10

delta$_x$ 1.0

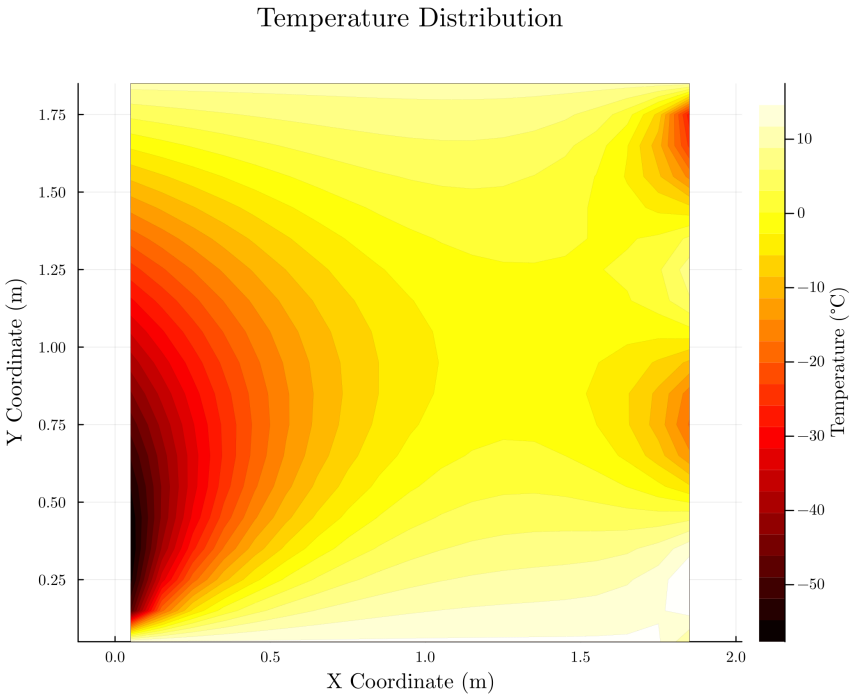
delta$_y$ 1.0



2.2 Plot with n = 20

delta$_x$ 0.1

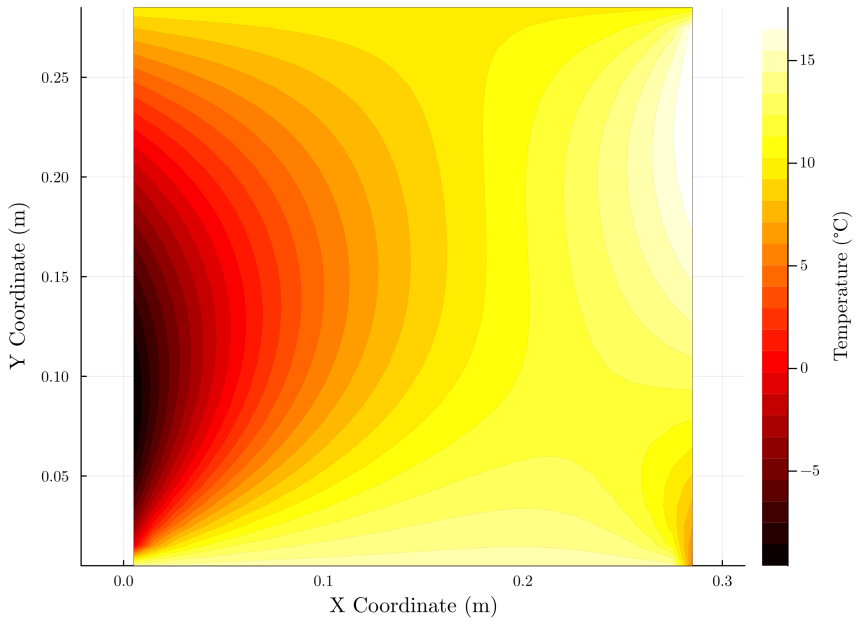
delta$_y$ 0.1



2.3 $\mathbf{n = 30}$

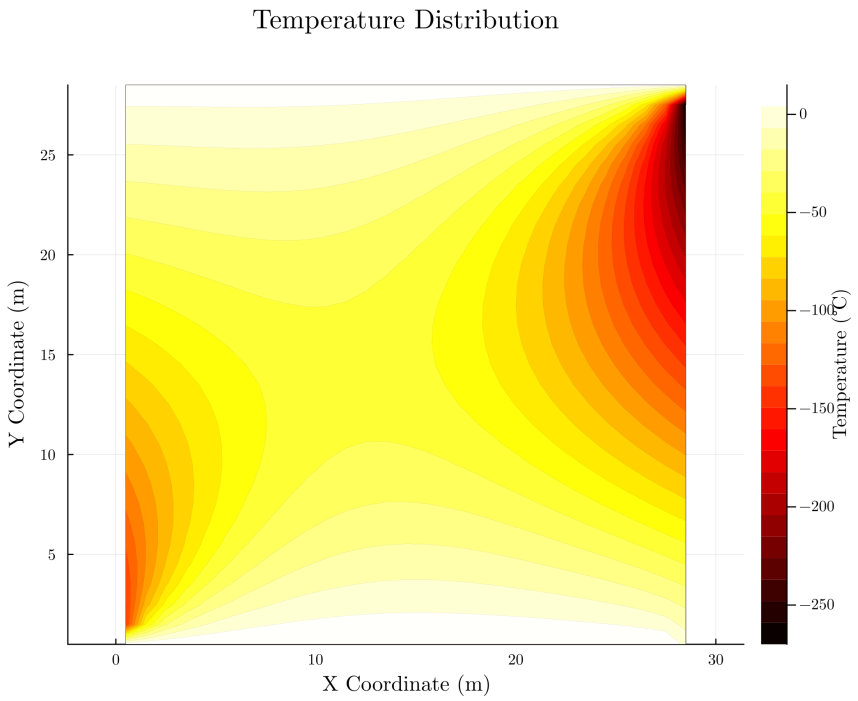
delta$_\mathbf{x}$ 0.01

delta$_\mathbf{y}$ 0.01



delta$_x$ 1.0

delta$_y$ 1.0

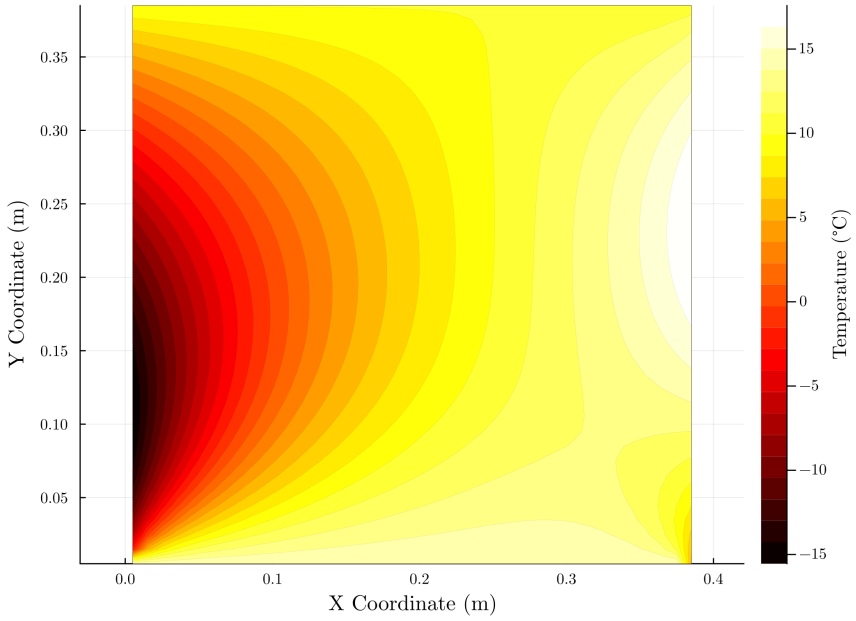


2.4 Plot withn n = 40

delta$_x$ 0.01

delta$_y$ 0.01

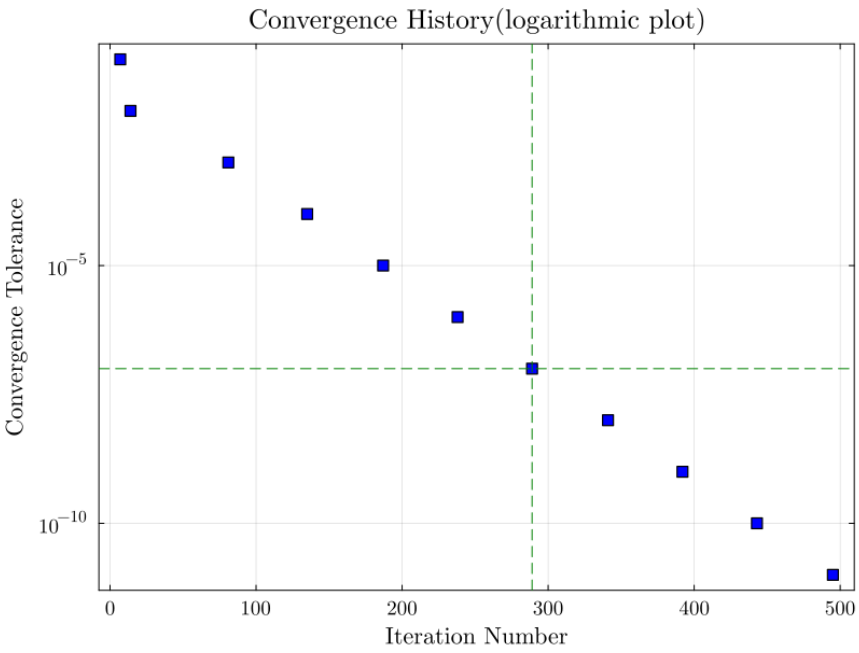
Temperature Distribution



3 Convergence History

This section contain the number of iteration required to achive desired convergence . the data is obtained and convergence history is plotted against logarithmic tolerane value

Tolerance	Iteration Number
0.1	7
0.01	14
0.001	81
0.0001	135
1e-05	187
1e-06	238
1e-07	289
1e-08	341
1e-09	392
1e-10	443
1e-11	495


Convergence History(logarithmic plot)
Convergence Tolerance
10^{-5}
10^{-10}
0
100
200
300
400
500
Iteration Number