NATIONAL INSTITUE OF TECHNOLOGY KARANATAKA, SURATHKAL

ASSIGNMENT 10

APPLIED COMPUTATIONAL METHODS IN MECHANICAL SCIENCES

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ASSIGNMENT ON ELLPITICAL PDE – 2D PLATE TEMPERATURE DISTRIBUTION

Answer

- Error limit was relaitive approximate error < $1e^{-4}$
- Grid independence study was done comparing the mid-line y Temperature for different grids and grid size of 0.3m was found to be grid independent.

Code(C++)

```cpp
1   #include<iostream>
2   #include<cmath>
3   #include<fstream>
4   using namespace std;
5   main()
6   {
7       fstream f;
8       f.open("DATA.txt",ios::out);
9       int Nr=11,Nc=9,i,j,iter=0;
10      float T[Nr][Nc]={j },dx,dy,error,Ae,Ap,An,Tleft=75,Ttop=300, Tbottom=50,
Tright=100,omega=1.5,max_error,temp,l=3.0,b=2.4;
11      dx=b/(Nc-1);
12      dy=l/(Nr-1);
13      cout<<dx<<" "<<dy;
14      Ae=1/(pow(dx,2));
15      An=1/(pow(dy,2));
16      Ap=-(2*Ae+2*An);
17      for(j=0;j<Nc;++j)
18      {
19          T[0][j]=Tbottom;
20          T[Nr-1][j]=Ttop;
21      }
22      for(i=1;i<Nr-1;++i)
23      {
24          T[i][0]=Tleft;
25          T[i][Nc-1]=Tright;
26      }
27      do
28      {
29          ++iter;
30          for(i=1;i<Nr-1;++i)
31          {
32              for(j=1;j<Nc-1;++j)
33              {
34                  temp=T[i][j];
35                  T[i][j]=(1-omega)*T[i][j]-omega*(Ae*(T[i][j+1]+T[i][j-1]) +
An*(T[i+1][j]+T[i-1][j]))/Ap;
36                  error=abs(temp-T[i][j])/T[i][j];
37                  if(i==1 && j==1)
38                      max_error=error;
39                  else
40                  {
41                      if(error>max_error)
42                          max_error=error;
43                  }
44              }
45          }
46          cout<<max_error<<"\n";
47      }while(max_error>1e-4);
48      for(i=Nr-1;i>=0;--i)
49      {
50          for(j=0;j<Nc;++j)
51              f<<T[i][j]<<" ";
52          f<<"\n";
53      }
54      cout<<"\nNo. of iterations: "<<iter;
55  }
```

Grid Independence Study: Grid size = 0.3 m in x and y direction i.e.10 X 8
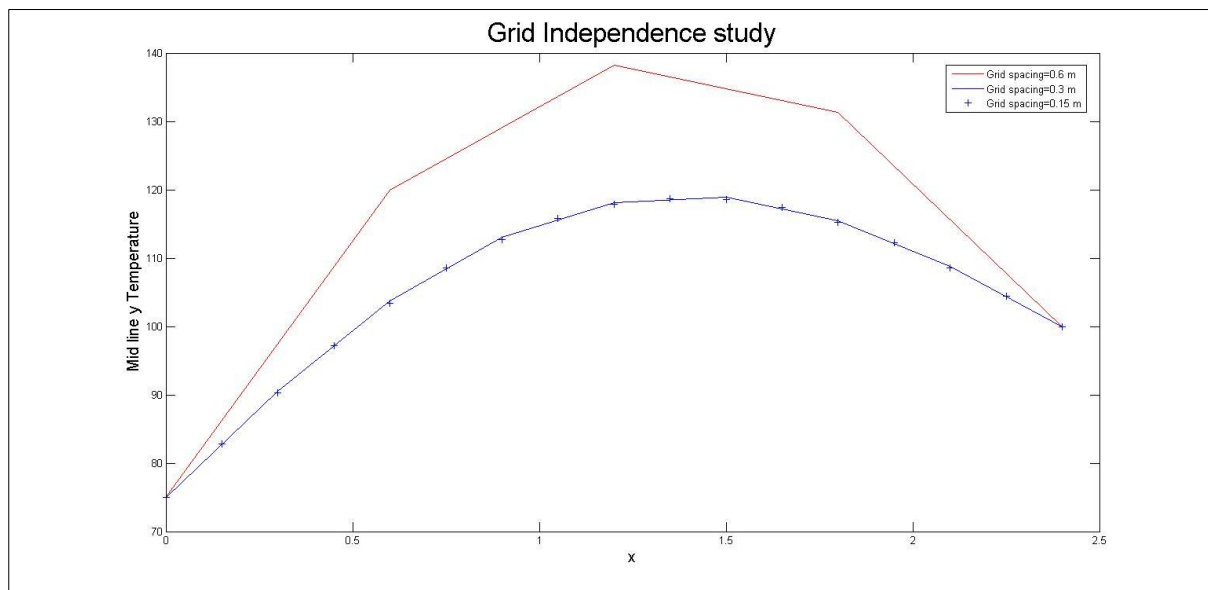
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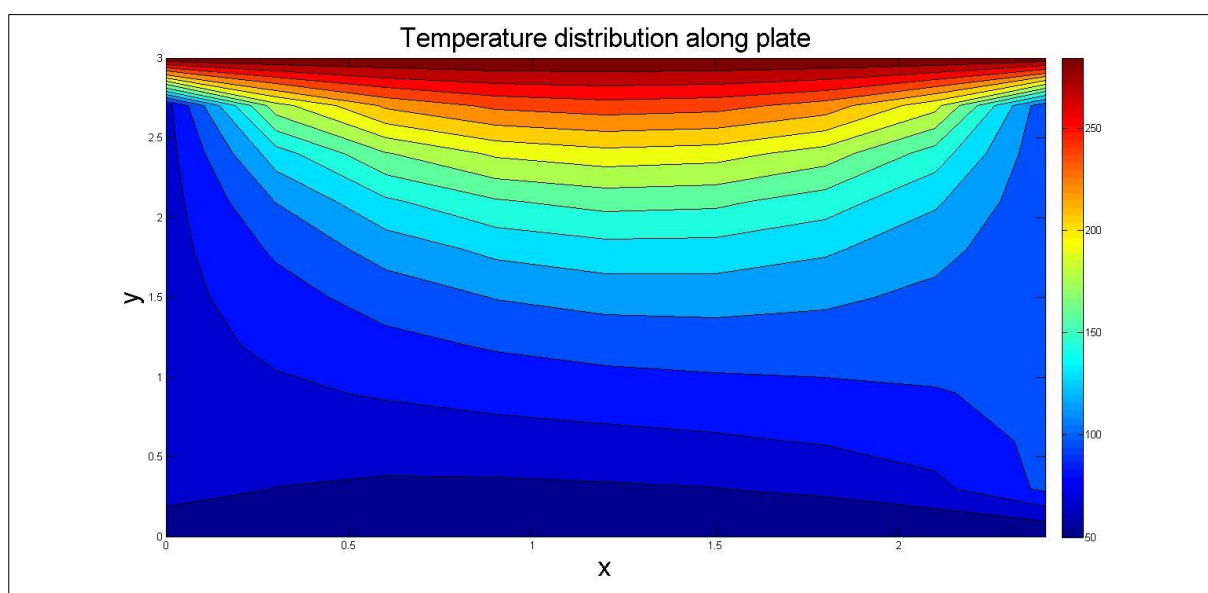
Optimization of SOR factor omega

Omega	No. Of Iterations
0.5	161
1	63
1.5	20

Opitmum Omega = 1.5.