

Figure 1: "Normal" mesh for the rectangular geometry

SF2520 - Laboratory 5

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Introduction

In this report we present the results of Lab 5. We had to solve an elliptic problem using first Matlab and then Comsol Multiphysics.

1 Matlab finite difference solution

bla

2 Comsol Multiphysics solution

In this section, we are going to solve the problem presented above with Comsol Multiphysics.

This is a Laplace equation and Comsol have already a nice setup for us. All we have to do is impose boundary conditions and generate the mesh. By default, Comsol sets zero flux boundary conditions so we just have to specify the Dirichlet conditions on the left and right sides. Once we have done this, we first use a mesh of type "normal". Figure 1 shows what the "normal" mesh looks like for our geometry.

This mesh contains 316 triangles and 679 nodes.mmmmmm....

Figure 2 shows the solution for this choice of mesh. We can see that it is very similar to the one in section 1 which is a linear function between $x = 0$ and $x = 4$. We also used a probe to check the temperature at $(x, y) = (2, 1)$.

$$T(2, 1) = 450.0000000001594$$

That is very close to the analytic value and the error is only due to floating point computation.

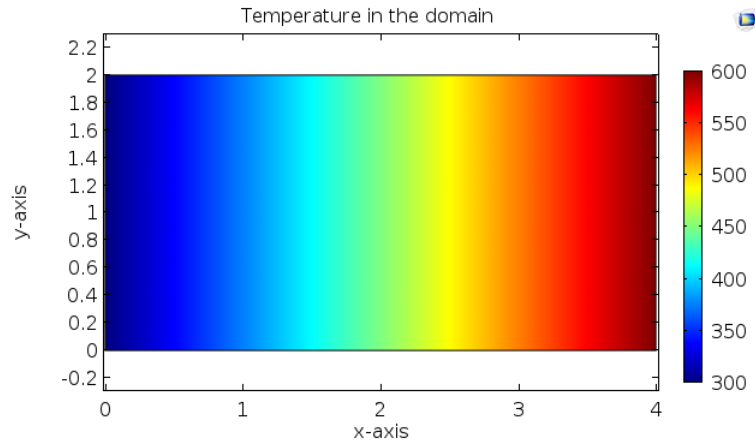


Figure 2: Solution of the given problem with Comsol

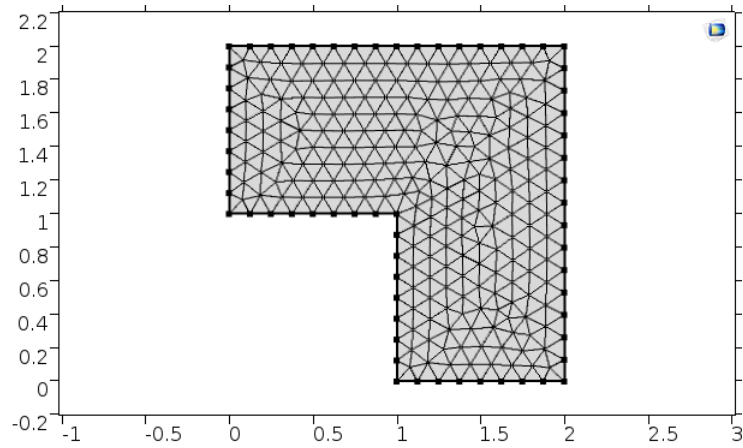


Figure 3: Geometry and mesh for the L-shaped domain

We are now going to refine the mesh. We switch from "normal" to "fine". There are now 476 triangles and 1022 nodes.je ne te crois pas...

We have another $T - value$ and:

$$T(2, 1) = 450.000000000236$$

We can see that the two values are extremely close to each other and as we said, the small difference is due to floating point errors.

We finally restart all over again with a "normal" mesh. After having set all needed values, Comsol plots the solution given in figure 2.

3 More Comsol

We are now going to consider a more complex geometry. The L-shaped area and the corresponding "normal" mesh are given in figure Lmesh.

This mesh contains 489 triangles. The solution computed by Comsol is given in figure 4.

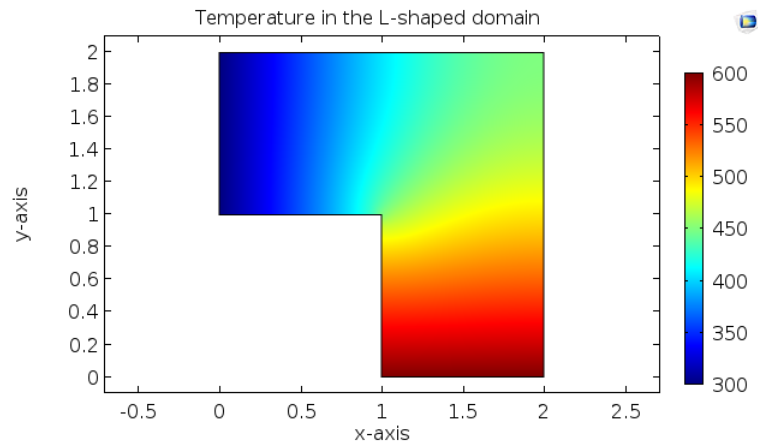


Figure 4: Solution for the L-shaped domain

Codes

```
h = 0.2;
N = 19; M = 11;% N is x-direction. M is y-direction
n = N*(M+2);% size of system
e = ones(n,1);
A = spdiags([-e -e 4*e -e -e],[-N -1 0 1 N],n,n);
%1) add known values on sides in term b
b = zeros(n,1);
b(1:N:end) = 300;
b(N:N:end) = 600;
for i = 1:M-1
    A(2+i*N, 2+i*N-1) = 0;
    A(N+(i-1)*N, N+(i-1)*N +1) = 0;
end

%2) correct lower and upper equations with ghost points etc
for i = 1:N
    A(i,i+N) = -2;
    A(end-i+1, end-i+1-N) = -2;
end

U = A\b;
U = reshape(U,N,M+2)';
U = [300*ones(M+2,1) U 600*ones(M+2,1)];
imagesc(U)
```