Contents


```
clear all; close all; format long; clc
axisSize=14;
markersize=20;
linewidth=5;
Lx = 4;
Ly = 2;
Mv = [2 1 0.5]*128;
Nv = [2 1 0.5]*64;
CFL = 20;
Re = 2;
Sc = 0.25;
p1(1)=0;
p2(1)=0;
p3(1)=0;
for i=1:3
```

```
    M=Mv(i);
    N=Nv(i);
    if (M==128 && N==64)
        outputTime=[0.1 0.5 1 10];
    else
        outputTime=[0.1 0.5 1];
    end
    endtime=outputTime(end);
    hx = Lx/M;
    hy = Ly/N;
    if hx~=hy
        error('Cells not square')
    end
    time=0;
    dt = min(CFL*0.25*hx^2*Re,CFL*0.25*hx^2*Re*Sc);
    n=1;
    % Define the points of the different meshes
    xu=linspace(0,4,M+1);
    yu=linspace(-hy/2,2+hy/2,N+2);
    xv=linspace(-hx/2,4+hx/2,M+2);
    yv=linspace(0,2,N+1);
    xY=linspace(-hx/2,4+hx/2,M+2);
    yY=linspace(-hy/2,2+hy/2,N+2);

    [u,v,Y]=initialization(M,N,hx,hy);
    iter=1;
    t=0;
    while time < endtime
```

```
        if (time < outputTime(n) && time+dt >= outputTime(n))
            dt=outputTime(n)-time;
            n=n+1;
        else
            dt = min(CFL*0.25*hx^2*Re,CFL*0.25*hx^2*Re*Sc);
        end
```

Solve for u(x,y,t)

```
        u=ADI_u(u,M,N,dt,hx,hy,Re);
```

Solve for v(x,y,t)

```
        v=ADI_v(v,M,N,dt,hx,hy,Re);
```

Solve for Y(x,y,t)

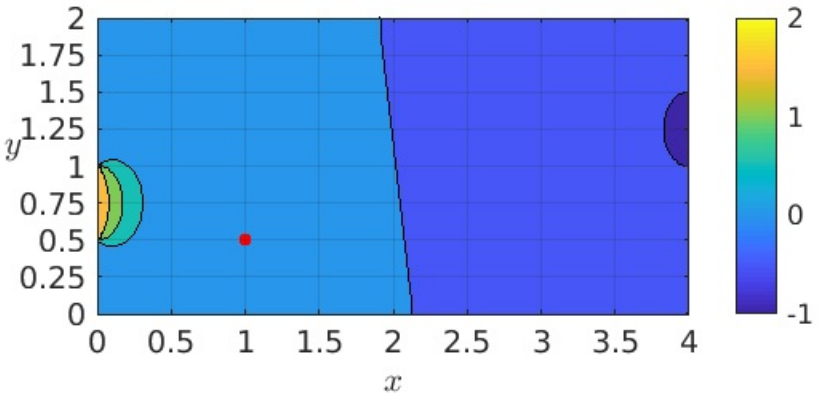
```
        Y=ADI_Y(Y,M,N,dt,hx,hy,Re,Sc);
```

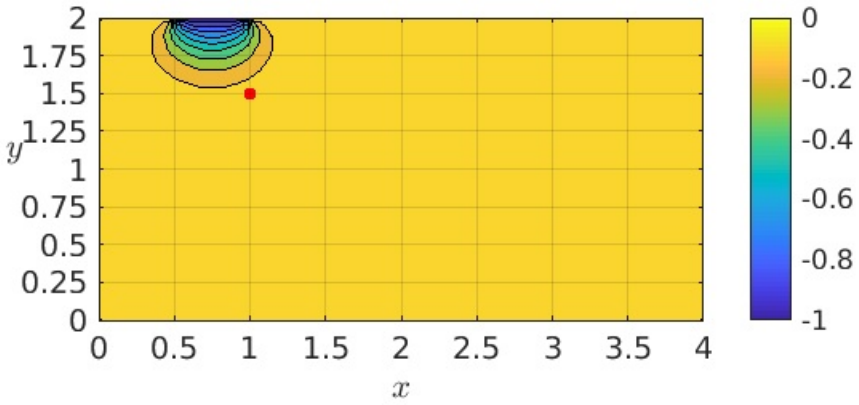
Next time step

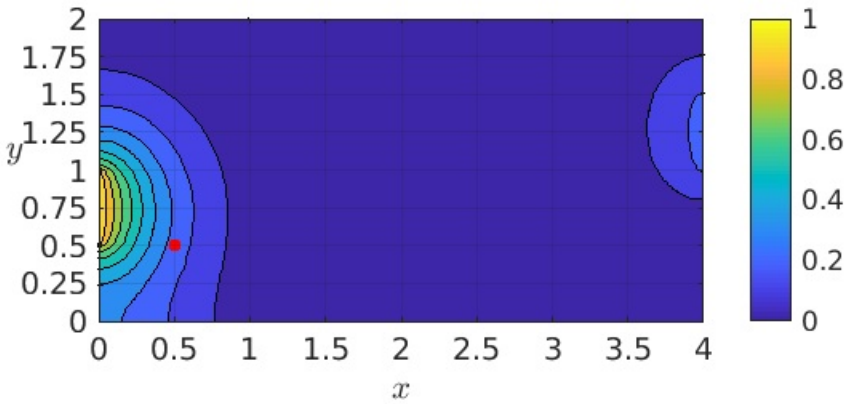
```
        time=time+dt;
```

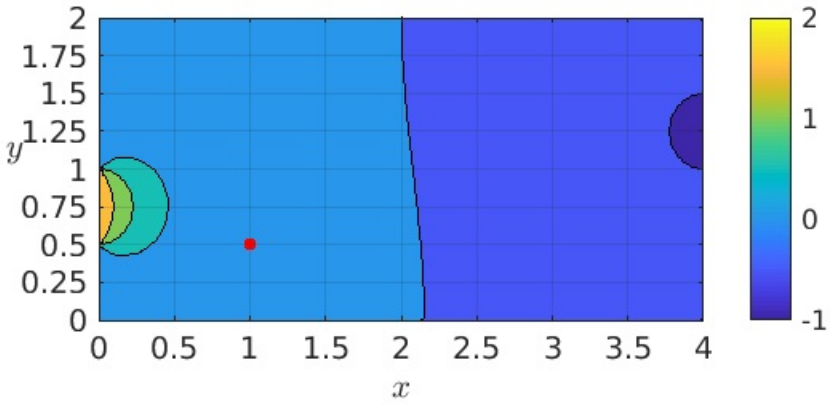
Filled contour plots, only for M=128 and N=64

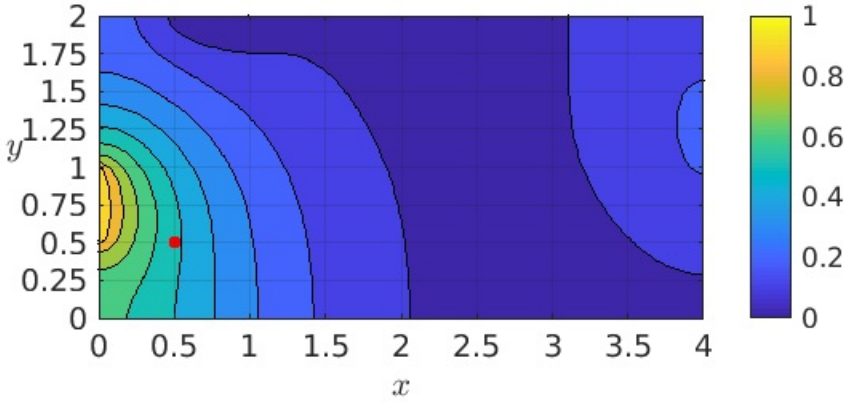
```
        if (M==128 && N==64 && ismember(time,outputTime))
            % Plot u
            figure(n-1)
            contourf(xu,yu,u')
            hold on
            plot(1,0.5,'r.','markersize',markersize,'linewidth',linewidth)
            axis([0 4 0 2])
            caxis([-1 2])
            colorbar
            xlabel('$x$','Interpreter','latex')
            ylabel('$y$','Interpreter','latex')
            yticks([0 0.25 0.50 0.75 1.0 1.25 1.50 1.75 2.0]);
            xticks([0 0.50 1.0 1.50 2.0 2.50 3.0 3.50 4.0]);
            set(get(gca,'ylabel'),'rotation',0)
            set(gca,'fontsize',axisSize)
            pbaspect([2 1 1])
            grid on
            txt=['Latex/FIGURES/u_' num2str(n)];
                saveas(gcf,txt,'epsc')
            % Plot v
            figure(n+3)
            contourf(xv,yv,v')
            hold on
            plot(1,1.5,'r.','markersize',markersize,'linewidth',linewidth)
            axis([0 4 0 2])
            caxis([-1 0])
            colorbar
            xlabel('$x$','Interpreter','latex')
            ylabel('$y$','Interpreter','latex')
            yticks([0 0.25 0.50 0.75 1.0 1.25 1.50 1.75 2.0]);
            xticks([0 0.50 1.0 1.50 2.0 2.50 3.0 3.50 4.0]);
            set(get(gca,'ylabel'),'rotation',0)
            set(gca,'fontsize',axisSize)
            pbaspect([2 1 1])
            grid on
            txt=['Latex/FIGURES/v_' num2str(n)];
                saveas(gcf,txt,'epsc')
            % Plot Y
            figure(n+7)
            contourf(xY,yY,Y')
            hold on
            plot(0.5,0.5,'r.','markersize',markersize,'linewidth',linewidth)
            axis([0 4 0 2])
            caxis([0 1])
            colorbar
            xlabel('$x$','Interpreter','latex')
            ylabel('$y$','Interpreter','latex')
            yticks([0 0.25 0.50 0.75 1.0 1.25 1.50 1.75 2.0]);
            xticks([0 0.50 1.0 1.50 2.0 2.50 3.0 3.50 4.0]);
            set(get(gca,'ylabel'),'rotation',0)
            set(gca,'fontsize',axisSize)
            pbaspect([2 1 1])
            grid on
            txt=['Latex/FIGURES/Y_' num2str(n)];
                saveas(gcf,txt,'epsc')
        end
```

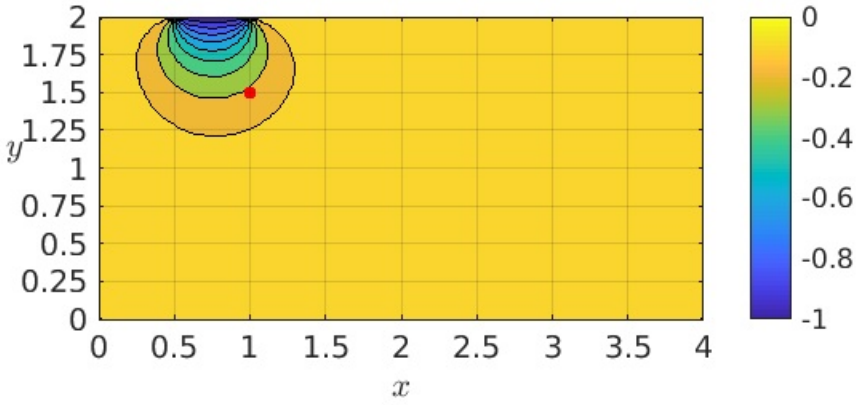

2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
2
1
0
-1

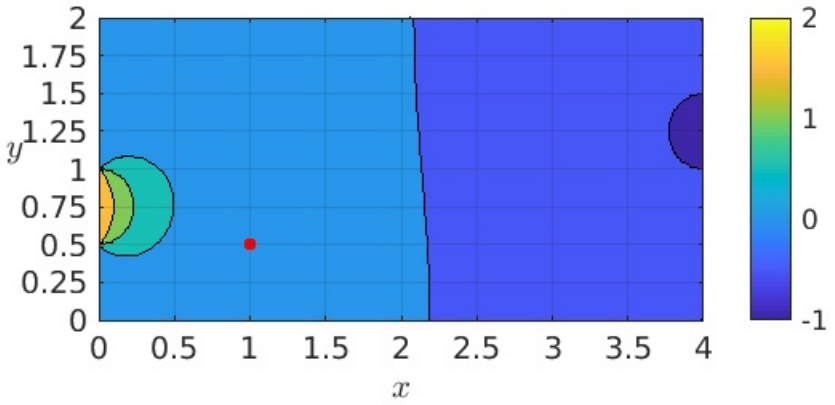

2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
0
-0.2
-0.4
-0.6
-0.8
-1

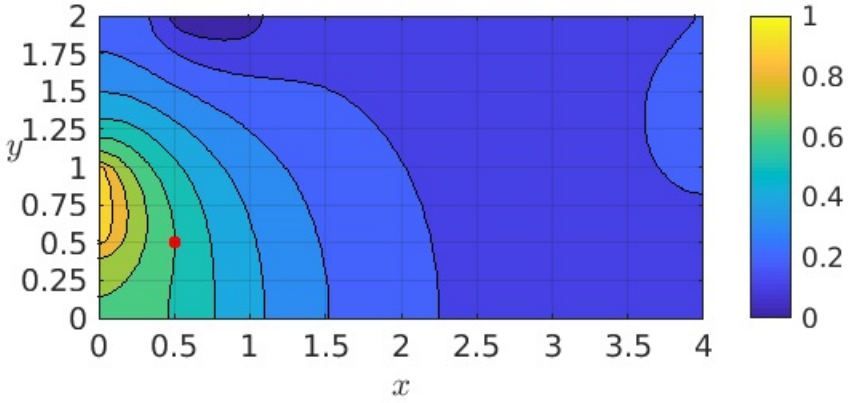

2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
1
0.8
0.6
0.4
0.2
0

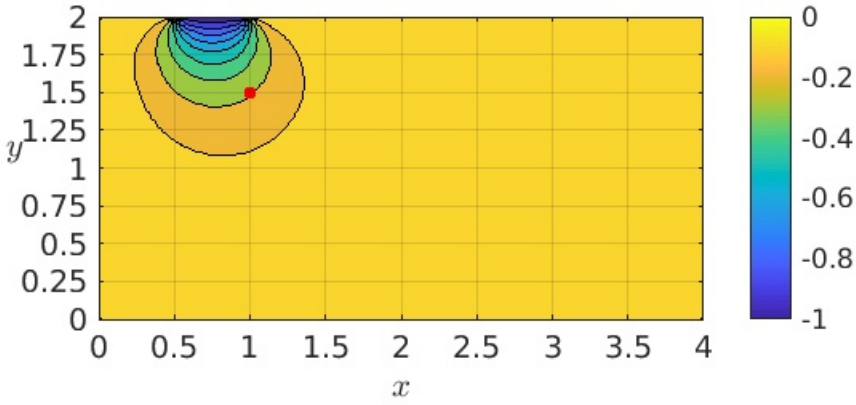

2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
2
1
0
-1

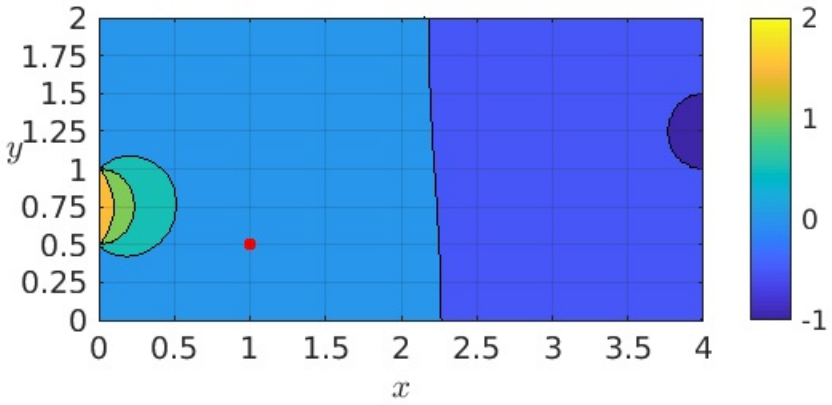

2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
1
0.8
0.6
0.4
0.2
0

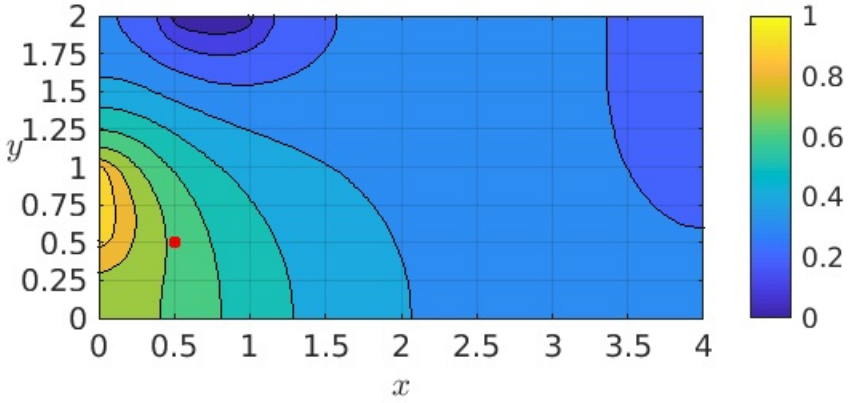

2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
0
-0.2
-0.4
-0.6
-0.8
-1

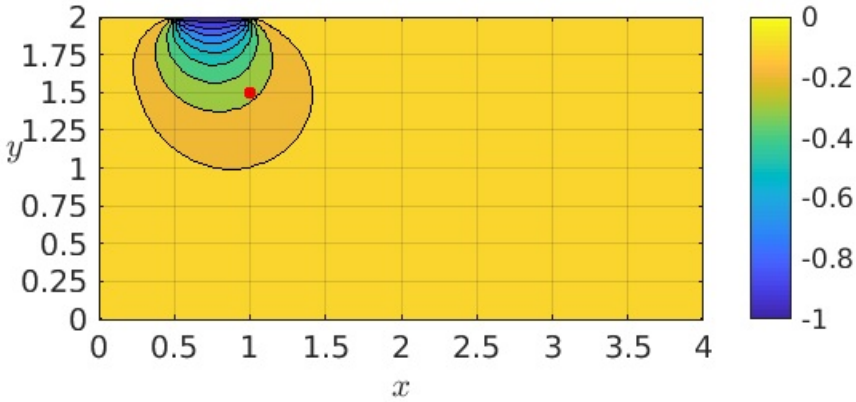

2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
2
1
0
-1


2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
1
0.8
0.6
0.4
0.2
0


2
1.75
1.5
1.25
1
0.75
0.5
0.25
0
y
0 0.5 1 1.5 2 2.5 3 3.5 4
x
0
-0.2
-0.4
-0.6
-0.8
-1







Probes, only for M=128 and N=64

```
        if (M==128 && N==64)
            iter=iter+1;
            t=[t;time];
            p1(iter) = (u (find(xu==1),find(yu<=0.5,1,'last'))...
                +u (find(xu==1),find(yu>=0.5,1)))/2;
            p2(iter) = (v (find(xv<=1,1,'last'),find(yv==1.5))...
                +v (find(xv>=1,1),find(yv==1.5)))/2;
            p3(iter) = (Y (find(xY<=0.5,1,'last'),find(yY<=0.5,1,'last'))...
                +Y (find(xY<=0.5,1,'last'),find(yY>=0.5,1))...
                +Y (find(xY>=0.5,1),find(yY<=0.5,1,'last'))...
                +Y (find(xY<=0.5,1),find(yY<=0.5,1)))/4;
        end
```

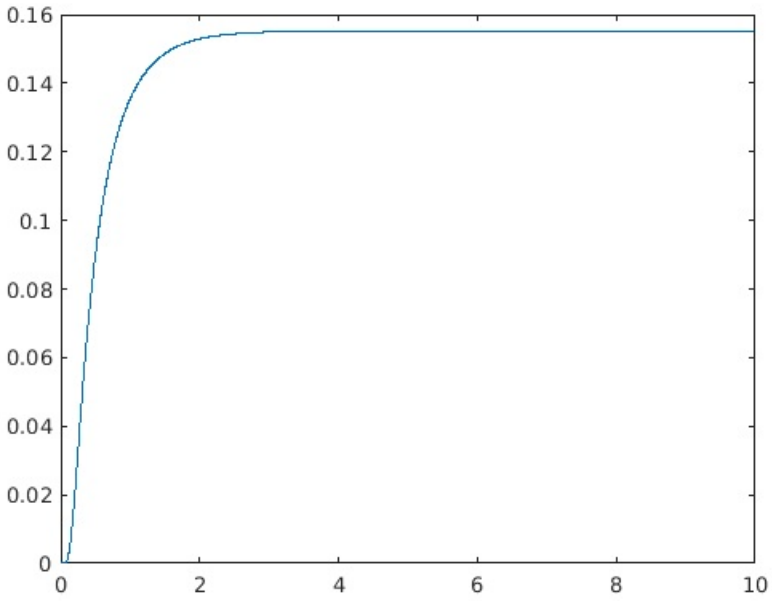
Probes value for u, v and Y at t=1

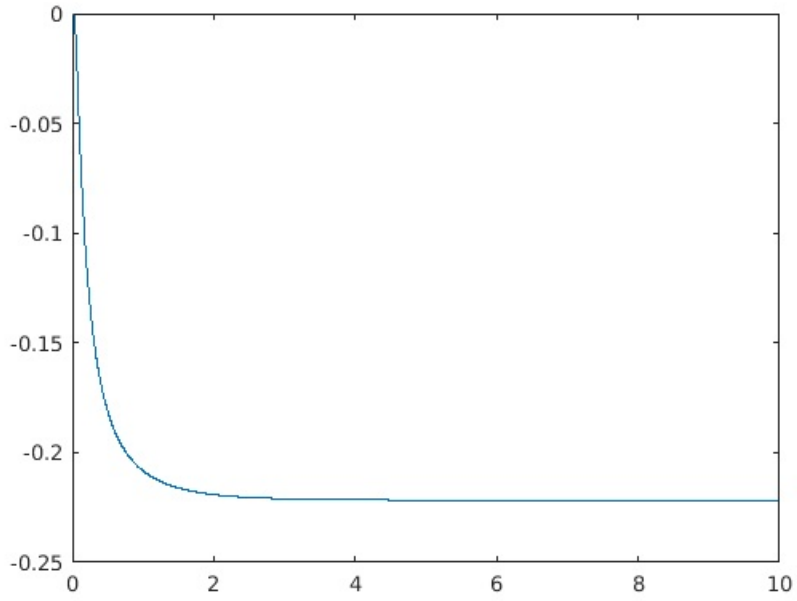
```
        if time==1
            p11(i)= (u (find(xu==1),find(yu<=0.5,1,'last'))...
                    +u (find(xu==1),find(yu>=0.5,1)))/2;
            p21(i)= (v (find(xv<=1,1,'last'),find(yv==1.5))...
                    +v (find(xv>=1,1),find(yv==1.5)))/2;
            p31(i)= (Y (find(xY<=0.5,1,'last'),find(yY<=0.5,1,'last'))...
                    +Y (find(xY<=0.5,1,'last'),find(yY>=0.5,1))...
                    +Y (find(xY>=0.5,1),find(yY<=0.5,1,'last'))...
                    +Y (find(xY<=0.5,1),find(yY<=0.5,1)))/4;
        end
```

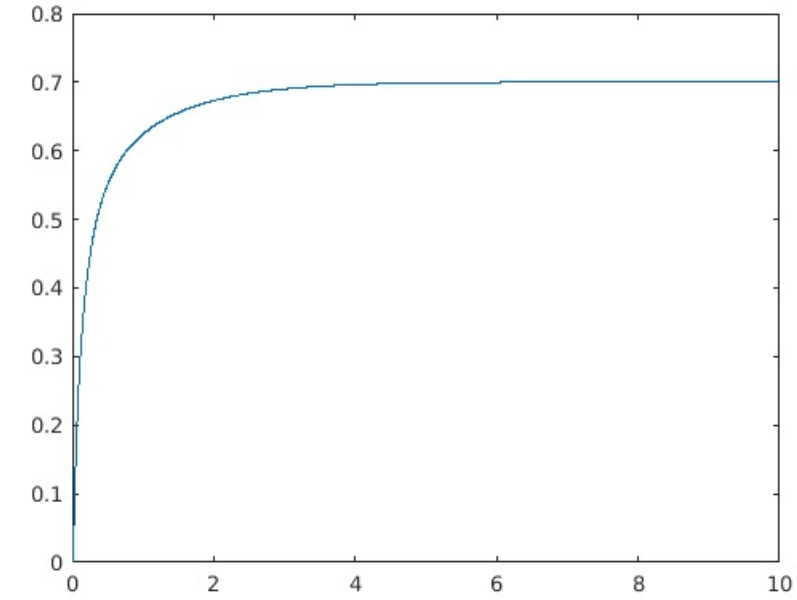
```
    end
```

Plot the probes, only for M=128 and N=64

```
    if (M==128 && N==64)
        figure
        plot(t,p1)
        figure
        plot(t,p2)
        figure
        plot(t,p3)
    end
```








```
end
```

GCI analysis

```
clc
r=2
Fsec=1.25
% Probe 1
p_u=log((p11(3)-p11(2))/(p11(2)-p11(1)))/log(r)
u_h0=p11(1)+(p11(1)-p11(2))/(r^p_u-1)
GCI21_u=Fsec*(p11(2)-p11(1))/(p11(1)*(r^p_u-1))
GCI32_u=Fsec*(p11(3)-p11(2))/(p11(2)*(r^p_u-1))
coeff_u=GCI21_u*r^p_u/GCI32_u
percent_u=GCI21_u*100
% pause

% Probe 2
p_v=log((p21(3)-p21(2))/(p21(2)-p21(1)))/log(r)
v_h0=p21(1)+(p21(1)-p21(2))/(r^p_v-1)
GCI12_v=Fsec*(p21(1)-p21(2))/(p21(1)*(r^p_v-1))
GCI23_v=Fsec*(p21(2)-p21(3))/(p21(2)*(r^p_v-1))
coeff_v=GCI12_v*r^p_v/GCI23_v
percent_v=GCI12_v*100
% pause

% Probe 3
p_Y=log((p31(3)-p31(2))/(p31(2)-p31(1)))/log(r)
Y_h0=p31(1)+(p31(1)-p31(2))/(r^p_Y-1)
```

```
GCI12_Y=Fsec*(p31(1)-p31(2))/(p31(1)*(r^p_Y-1))
GCI23_Y=Fsec*(p31(2)-p31(3))/(p31(2)*(r^p_Y-1))
coeff_Y=GCI12_Y*r^p_Y/GCI23_Y
percent_Y=GCI12_Y*100


load gong.mat;
sound(y);
```

```
r =

     2


Fsec =

   1.250000000000000


p_u =

   1.997009899696340


u_h0 =

   0.135440502299368


GCI21_u =

     1.045042006401645e-04


GCI32_u =

     4.170470158182023e-04


coeff_u =

   1.000250117700815


percent_u =

   0.010450420064016


p_v =

   2.012841410009195


v_h0 =

  -0.208331420237975


GCI12_v =

     1.030687806447006e-05


GCI23_v =

     4.159715708335120e-05


coeff_v =

   0.999974968609772


percent_v =

   0.001030687806447


p_Y =

   1.023405387089959
```

```
Y_h0 =

   0.628929392741961

GCI12_Y =

   0.004628023636959

GCI23_Y =

   0.009443544004055

coeff_Y =

   0.996176469846528

percent_Y =

   0.462802363695942
```

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