Contents

CHAPTER 0 : set the global variables needed by the drivers

```
clear all;
close all;
run('../../../SOURCES_MATLAB/SF_Start.m');
figureformat='png'; AspectRatio = 0.56; % for figures
tinit = tic;
verbosity=0;
Ma = 0.2;
Re = 150;

% NB the drivers may produce warning messages such as "rm: ./WORK/*.txt: No such file or di
rectory"
% don't mind them, this should disapear in future evolutions of StabFem
```

Chapter 1 : Italian-style mesh (multiple imbricated zones)

1A : mesh creation

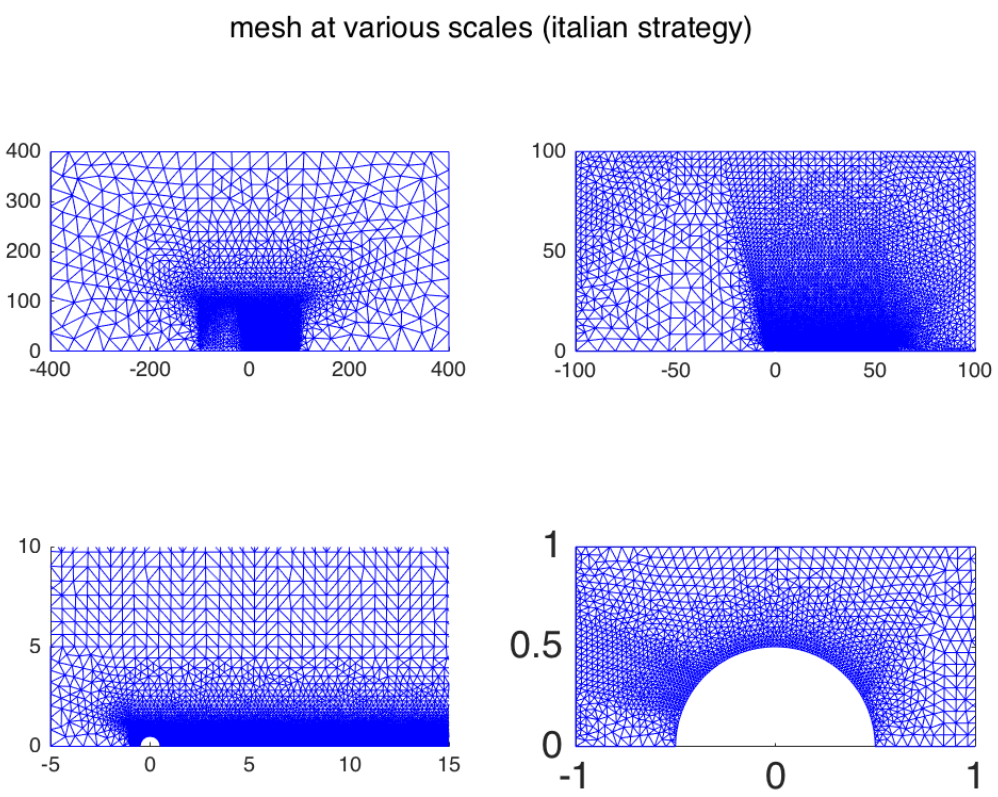
```
% Mesh in the style of that used by Fani et al, but on half-domain
% parameters for mesh creation ; Italian method
xinfm=-100.; xinfv=100.; yinf=100.;% Outer Domain
x1m=-1; x1v=30.; y1=1;% Inner domain
x2m=-5.;x2v=60.;y2=5;% Middle domain
ls=300.0; % Sponge extension
% Refinement parameters
n=1.8; % Vertical density of the outer domain
ncil=60; % Refinement density around the cylinder
n1=30; % Density in the inner domain
n2=3; % Density in the middle domain
ns=.5; % Density in the outer domain
nsponge=.05; % density in the sponge region

ParamsForSponge = [xinfm,xinfv,yinf,x1m,x1v,y1,x2m,x2v,y2,ls,n,ncil,n1,n2,ns,nsponge];
mesh = SF_Mesh('Mesh_HalfDomain_WITHSUBZONES.edp','Params',ParamsForSponge);
% Number of vertices in this mesh :
```

```
mesh.np
```

```
rm: ./WORK/BASEFLOWS/*: No such file or directory

ans =

       21112
```

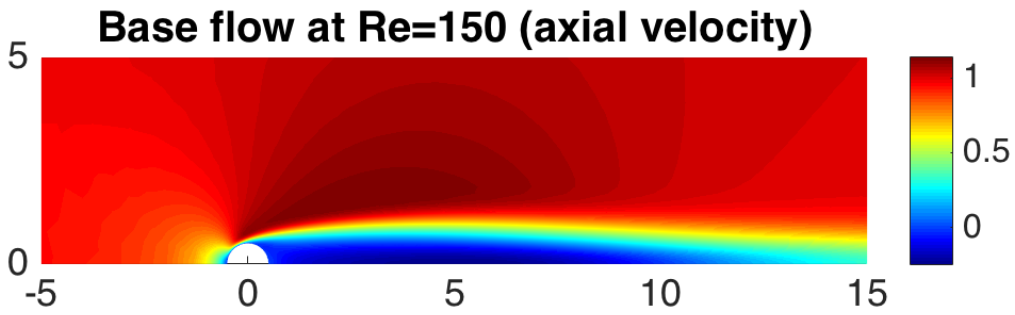
Plot this mesh

```
figure;
subplot(2,2,1);SF_Plot(mesh);
subplot(2,2,2);SF_Plot(mesh,'xlim',[-100 100],'ylim',[0 100]);
subplot(2,2,3);SF_Plot(mesh,'xlim',[-5 15],'ylim',[0 10]);
subplot(2,2,4);SF_Plot(mesh,'xlim',[-1 1],'ylim',[0 1]);
suptitle('mesh at various scales (italian strategy)');
pause(1);
box on;
set(gca,'FontSize', 18);
saveas(gca,'Cylinder_Compressible_ItalianMesh',figureformat);
pause(0.1);
```



1B. Computation of a BF for Re = 150, Ma = 0.2

```
bf=SF_BaseFlow(mesh,'Re',1,'Mach',0.2);
bf=SF_BaseFlow(bf,'Re',60,'Mach',0.2);
bf=SF_BaseFlow(bf,'Re',150,'Mach',0.2);

figure();
SF_Plot(bf,'ux','xlim',[-5 15],'ylim',[0 5]);
title('Base flow at Re=150 (axial velocity)');
box on; pos = get(gcf,'Position'); pos(4)=pos(3)*AspectRatio;set(gcf,'Position',pos); % res
ize aspect ratio
set(gca,'FontSize', 18);
saveas(gca,'Cylinder_BaseFlowRe60Ma02',figureformat);
pause(0.1);
```

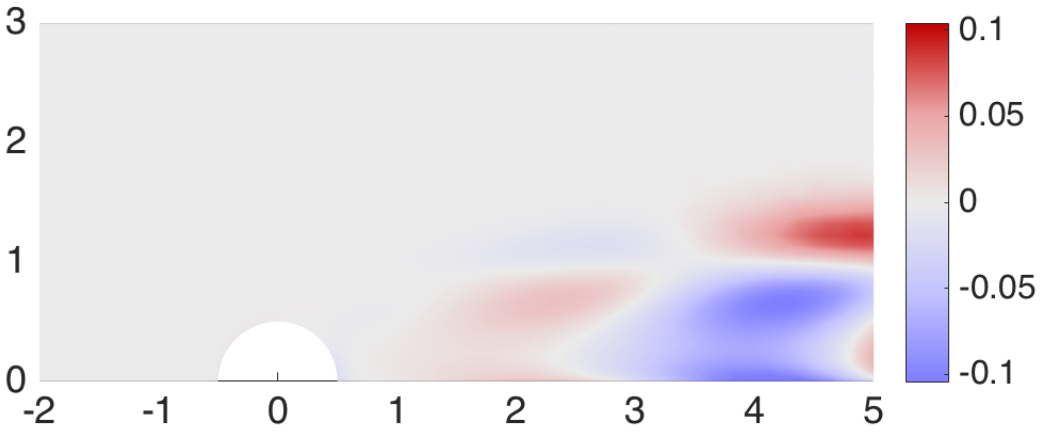


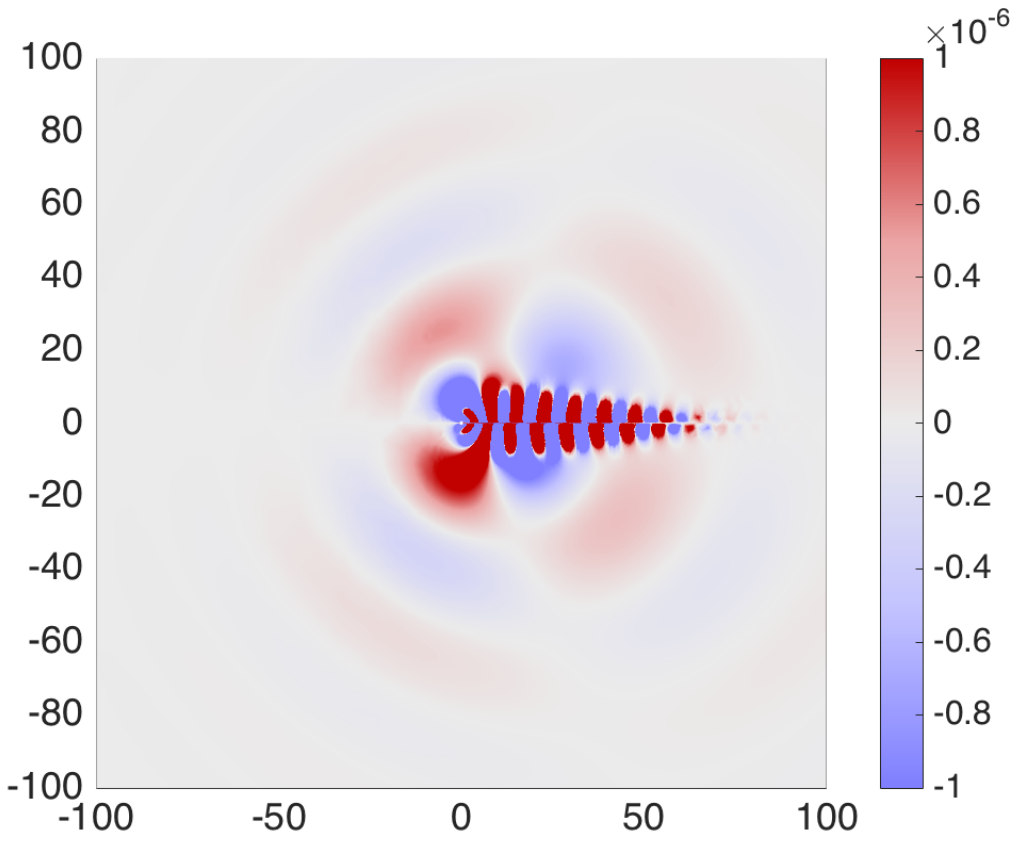
Chapter 1C : Compute eigenmode

```
%Plot eigenmode (figure 6 of Fani et al)
[ev,emD] = SF_Stability(bf,'shift',0.152 + 0.642i,'nev',1,'type','D','sym','N');

figure;
SF_Plot(emD,'vort1','xlim',[-2 5],'ylim',[0 3],'colorrange','cropcentered','colormap','redb
lue');
box on; pos = get(gcf,'Position'); pos(4)=pos(3)*AspectRatio;set(gcf,'Position',pos); % res
ize aspect ratio
set(gca,'FontSize', 18);
saveas(gca,'Cylinder_EigenmodeRe60Ma02_vort',figureformat);
pause(0.1);

%
figure;
SF_Plot(emD,'p1','xlim',[-100 100],'ylim',[-100 100],'colorrange',[-1e-6,1e-6],'colormap','
redblue');
hold on;
SF_Plot(emD,'p1.im','xlim',[-100 100],'ylim',[-100 100],'colorrange',[-1e-6,1e-6],'colormap
','redblue','symmetry','XM');
```

```
box on;
set(gca,'FontSize', 18);
saveas(gca,'Cylinder_EigenmodeRe60Ma02_p',figureformat);
pause(0.1);
```

```
      # Stability calculation completed, eigenvalue = 0.152+0.64526i ; converged in 4 itera
tions
```





Chapter 2 : New adapted mesh using flow structures and "masks".

2.A : mesh generation

```
% First create an initial mesh in the simplest way
mesh = SF_Mesh('Mesh_HalfDomain.edp','Params',[-100,100,100,200,.1,60]);
bf=SF_BaseFlow(mesh,'Re',1,'Mach',0.2);

% First adaptation with only one mask and BF (do it twice)
Mask = SF_Launch('AdaptationMask.edp','Type','rectangle','Params',[-100 100 -100 100 4],'Me
sh',bf.mesh,'DataFile','Mask.ff2m')
bf = SF_Adapt(bf,Mask,'Hmax',50);
Mask = SF_Launch('AdaptationMask.edp','Type','rectangle','Params',[-100 100 -100 100 4],'Me
sh',bf.mesh,'DataFile','Mask.ff2m')
bf = SF_Adapt(bf,Mask,'Hmax',50);

% Raise the Re to 150
bf=SF_BaseFlow(bf,'Re',60,'Mach',0.2);
bf=SF_BaseFlow(bf,'Re',150,'Mach',0.2);

% Compute the eigenmode and two 'masks'
% eigenmode
[ev,emD] = SF_Stability(bf,'shift',0.152 + 0.642i,'nev',1,'type','D','sym','N'); % NB PROBL
EM in type='A' mode

% First 'mask' function to enforce Hmax = 4 on [-100,100]x[0,100]
Mask = SF_Launch('AdaptationMask.edp','Type','rectangle','Params',[-100 100 -100 100 4],'Me
sh',bf.mesh,'DataFile','Mask.ff2m')
% NB don't mind the three next lines ; such filename manipulations will be
```

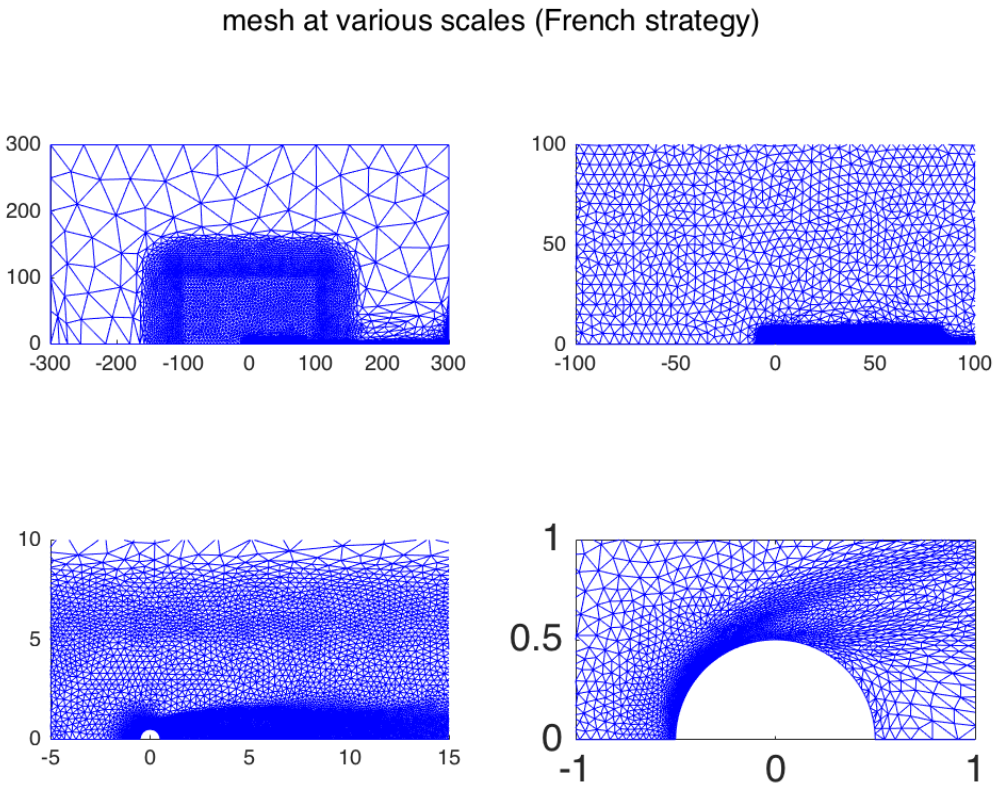
```
% integrated automatically in the driver in due time !
mycp('WORK/Mask.txt','WORK/Mask1.txt');
mycp('WORK/Mask.ff2m','WORK/Mask1.ff2m');
Mask.filename = 'WORK/Mask1.txt';

% Second 'mask' function to enforce Hmax = .25 on [-2,10]x[0,3]
Mask2 = SF_Launch('AdaptationMask.edp','Type','rectangle','Params',[-5 80 -5 5 .25],'Mesh',
bf.mesh,'DataFile','Mask.ff2m')

% mesh adaptation to bf, eigenmodes and the two masks !
bf = SF_Adapt(bf,emD,Mask,Mask2,'Hmax',50);

% Number of vertices in this mesh :
bf.mesh.np
```

```
Mask =

              mesh: [1x1 struct]
          filename: './WORK/Mask.txt'
    DataDescription: 'Adaptation Mask'
          datatype: 'MASK'
    datastoragemode: 'CxP2P2'
             Maskx: [3191x1 double]
             Masky: [3191x1 double]

rm: ./WORK//MEANFLOWS/*: No such file or directory
rm: ./WORK/Eigenmode*: No such file or directory

Mask =

              mesh: [1x1 struct]
          filename: './WORK/Mask.txt'
    DataDescription: 'Adaptation Mask'
          datatype: 'MASK'
    datastoragemode: 'CxP2P2'
             Maskx: [4369x1 double]
             Masky: [4369x1 double]

rm: ./WORK//BASEFLOWS/*: No such file or directory
rm: ./WORK//MEANFLOWS/*: No such file or directory
rm: ./WORK/Eigenmode*: No such file or directory
      # Stability calculation completed, eigenvalue = 0.13772+0.6385i ; converged in 5 iter
ations

Mask =

              mesh: [1x1 struct]
          filename: './WORK/Mask.txt'
    DataDescription: 'Adaptation Mask'
          datatype: 'MASK'
    datastoragemode: 'CxP2P2'
             Maskx: [4791x1 double]
             Masky: [4791x1 double]


Mask2 =
```

```
              mesh: [1x1 struct]
          filename: './WORK/Mask.txt'
    DataDescription: 'Adaptation Mask'
          datatype: 'MASK'
    datastoragemode: 'CxP2P2'
             Maskx: [4791x1 double]
             Masky: [4791x1 double]

rm: ./WORK//MEANFLOWS/*: No such file or directory

ans =

       16295
```

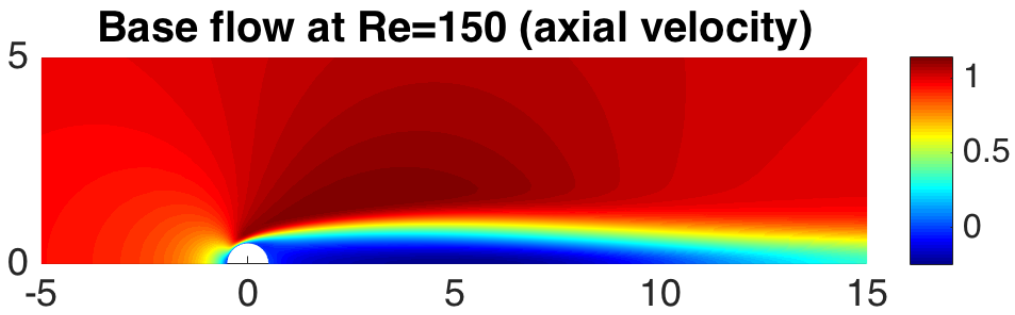
Chapter 2B : plot the mesh and BF

```
figure;
subplot(2,2,1);SF_Plot(bf.mesh,'xlim',[-300 300],'ylim',[0 300]);
subplot(2,2,2);SF_Plot(bf.mesh,'xlim',[-100 100],'ylim',[0 100]);
subplot(2,2,3);SF_Plot(bf.mesh,'xlim',[-5 15],'ylim',[0 10]);
subplot(2,2,4);SF_Plot(bf.mesh,'xlim',[-1 1],'ylim',[0 1]);
suptitle('mesh at various scales (French strategy)');
pause(1);
box on;
set(gca,'FontSize', 18);
saveas(gca,'Cylinder_Compressible_FrenchMesh',figureformat);
pause(0.1);
```



Plot base flow (figure 2 of Fani et al)

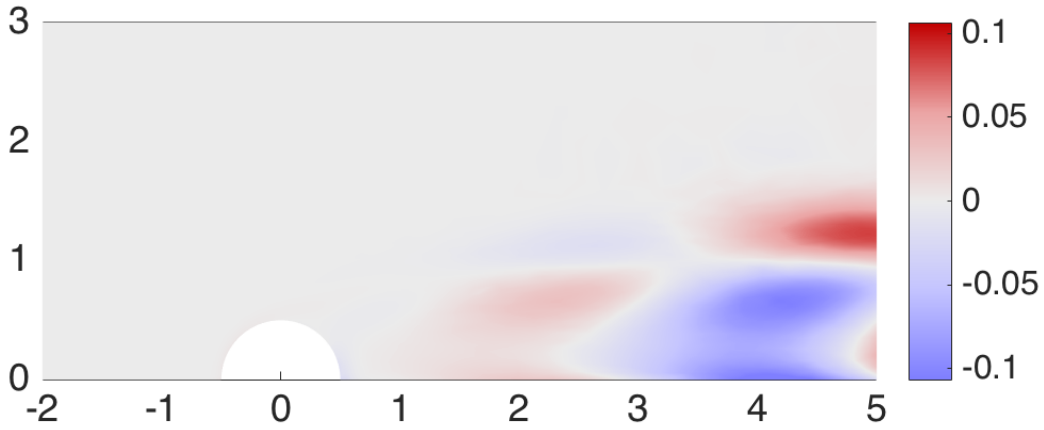
```
figure();
SF_Plot(bf,'ux','xlim',[-5 15],'ylim',[0 5]);
title('Base flow at Re=150 (axial velocity)');
box on; pos = get(gcf,'Position'); pos(4)=pos(3)*AspectRatio;set(gcf,'Position',pos); % res
ize aspect ratio
set(gca,'FontSize', 18);
saveas(gca,'Cylinder_BaseFlowRe60Ma02',figureformat);
pause(0.1);
```

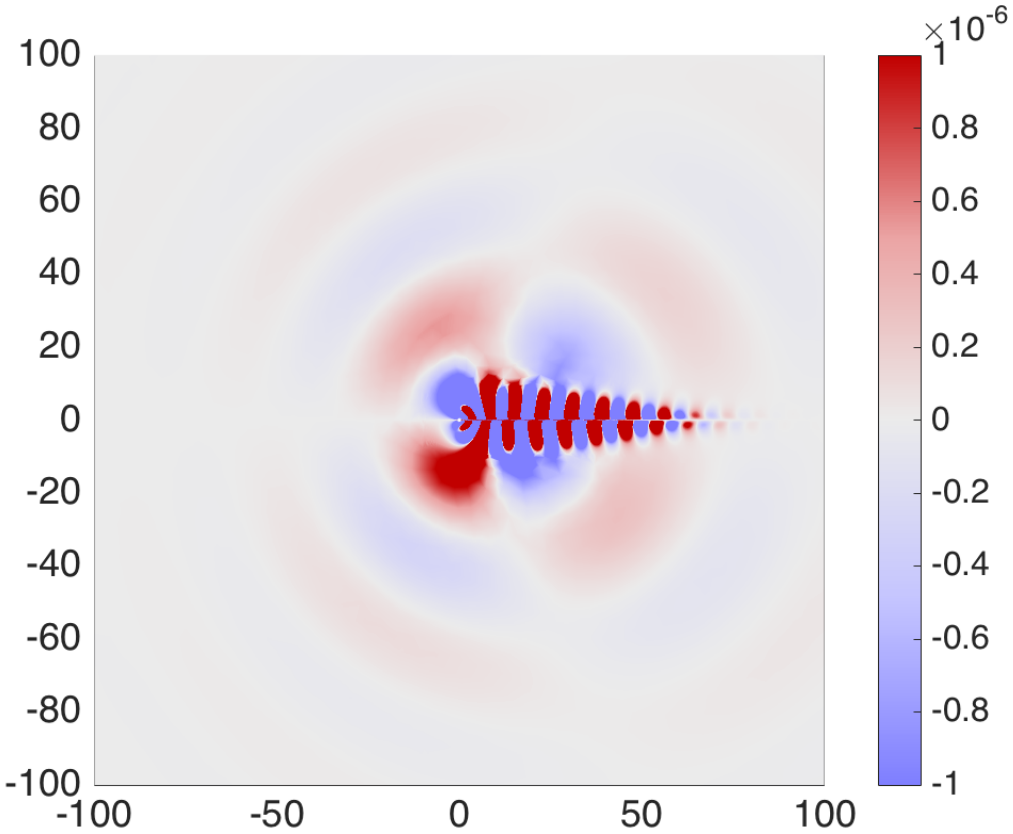


2.C : compute and plot eigenmode

```
%Plot eigenmode (figure 6 of Fani et al)
[ev,emD] = SF_Stability(bf,'shift',0.152 + 0.642i,'nev',1,'type','D','sym','N');

figure;
SF_Plot(emD,'vort1','xlim',[-2 5],'ylim',[0 3],'colorrange','cropcentered','colormap','redb
lue');
box on;
set(gca,'FontSize', 18);
saveas(gca,'Cylinder_EigenmodeRe60Ma02_vort',figureformat);
pause(0.1);
%
figure;
SF_Plot(emD,'p1','xlim',[-100 100],'ylim',[-100 100],'colorrange',[-1e-6,1e-6],'colormap','
redblue');
hold on;
SF_Plot(emD,'p1.im','xlim',[-100 100],'ylim',[-100 100],'colorrange',[-1e-6,1e-6],'colormap
','redblue','symmetry','XM');
box on;
set(gca,'FontSize', 18);
saveas(gca,'Cylinder_EigenmodeRe60Ma02_p',figureformat);
pause(0.1);
```

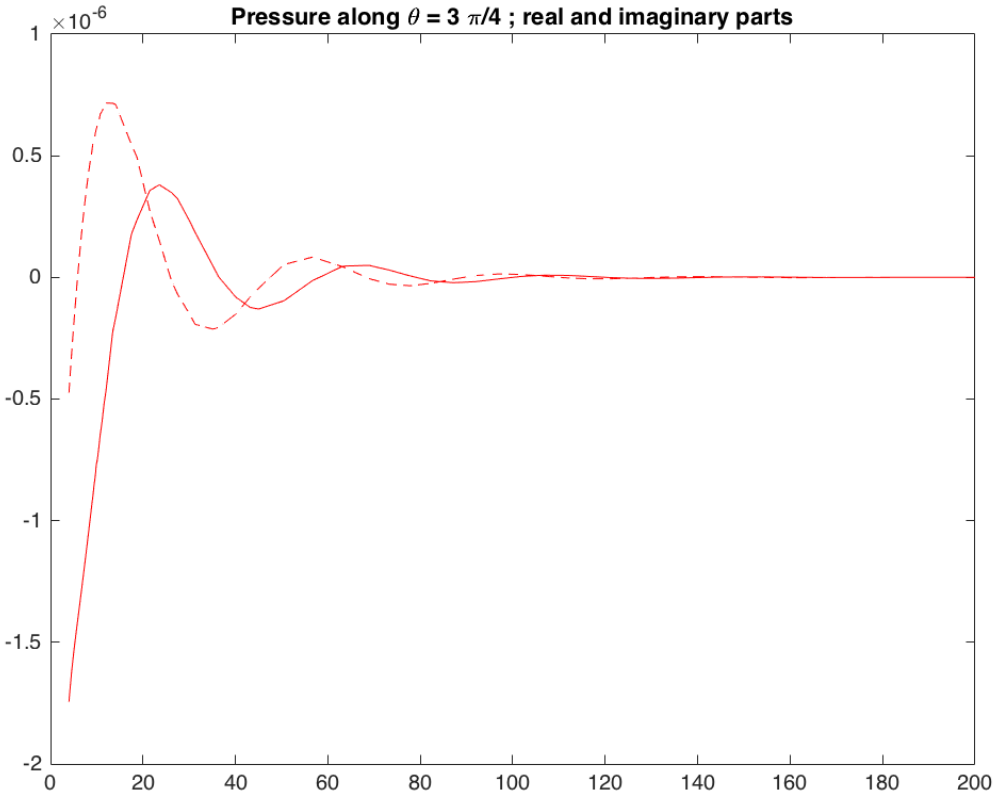
```
      # Stability calculation completed, eigenvalue = 0.15203+0.64537i ; converged in 4 ite
rations
```





2.D : Extract P along the the direction theta = (3*pi/4)

```
Rray= [4:.1:200];
Xray = Rray*cos(3*pi/4);Yray = Rray*sin(3*pi/4);
Pray = SF_ExtractData(emD,'p1',Xray,Yray);
figure;plot(Rray,real(Pray),'r-',Rray,imag(Pray),'r--')
title('Pressure along \theta = 3 \pi/4 ; real and imaginary parts')
```



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