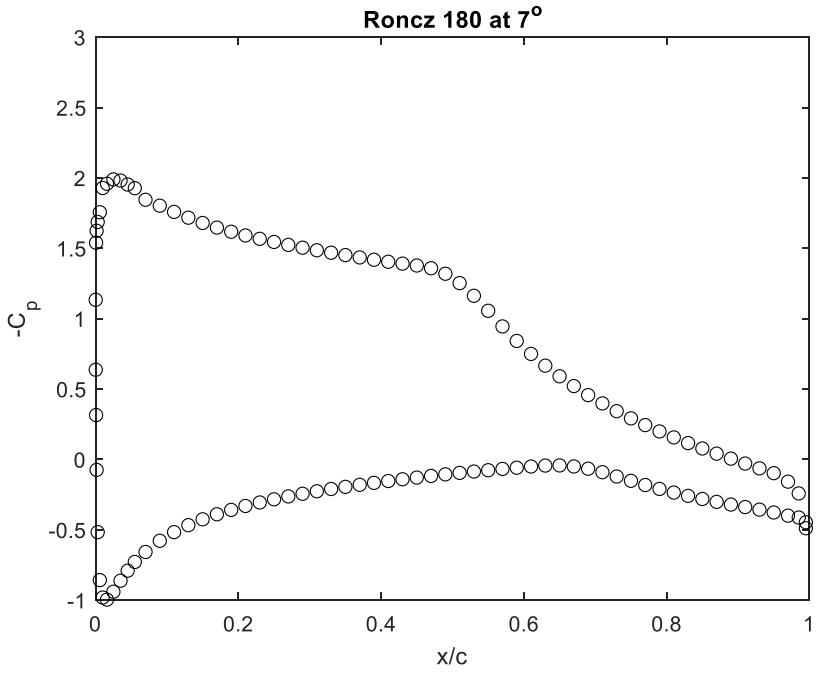
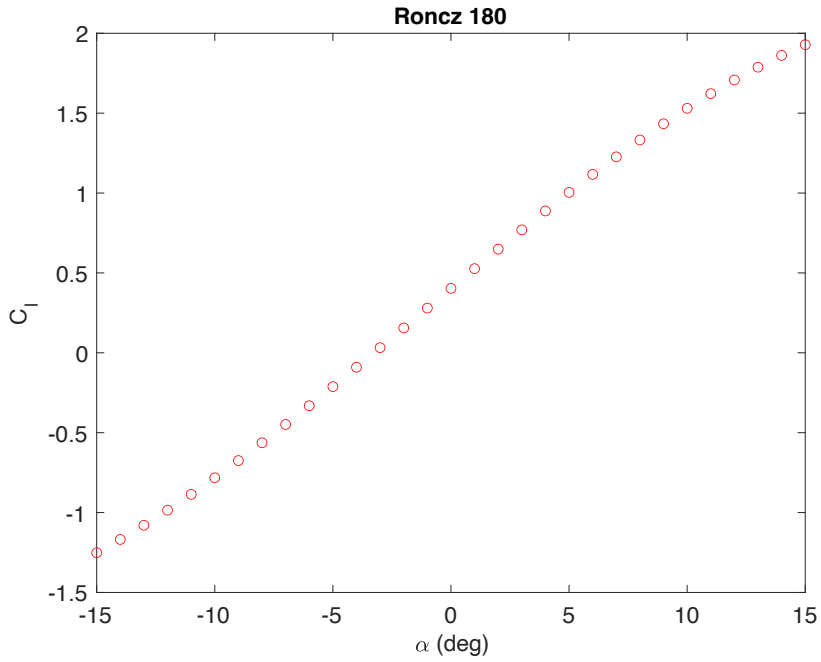
(a) Modified *linearVortexPanelKutta.m*. Modifications indicated below by triangular brackets

```
clear all;
%>>>>>Roncz 1080 Airfoil
x=[1     0.99     0.979999     0.959998     0.939998     0.919997     0.899996     0.879995     0.859994     0.839
y=[0     0.002591     0.005338     0.010402     0.015068     0.019713     0.02442 0.029202     0.034056     0.038
z=x+i*y;npanels=length(z);k=npanels;alpha=7*pi/180;
winf=exp(-i*alpha);
%<<<<<
a=[1:npanels];b=[2:npanels 1];c=[3:npanels 1 2];
dzds=(z(b)-z(a))./abs(z(b)-z(a));

eps=0.0001;
zc=(z(a)+z(b))/2-i*eps*(z(b)-z(a)); %control points

cm=zeros(npanels);
for m=1:npanels
cm(:,m)=-i*(((zc(m)-z(a))./(z(b)-z(a)).*log((zc(m)-z(a))./(zc(m)-z(b)))-1)./dzds(a)/2/pi...
          -((zc(m)-z(c))./(z(b)-z(c)).*log((zc(m)-z(c))./(zc(m)-z(b)))-1)./dzds(b)/2/pi)*dzds(m);
end
res=imag(-winf*dzds);
cm1=imag(cm);cm1(:,end)=0;cm1(k,end)=1;
res(end)=0;
q=res/cm1;

ut=real(q*cm+winf*dzds);
cp=1-ut.^2/abs(winf).^2;
figure
%>>>>>
plot(real(zc),-cp,'ko');
ylim([-1 3]);xlim([0 1]);
title('Roncz 180 at 7^o');xlabel('x/c');ylabel('-C_p');
%<<<<<
```



(b) Modified *linearVortexPanelKutta.m*. Modifications indicated below by triangular brackets

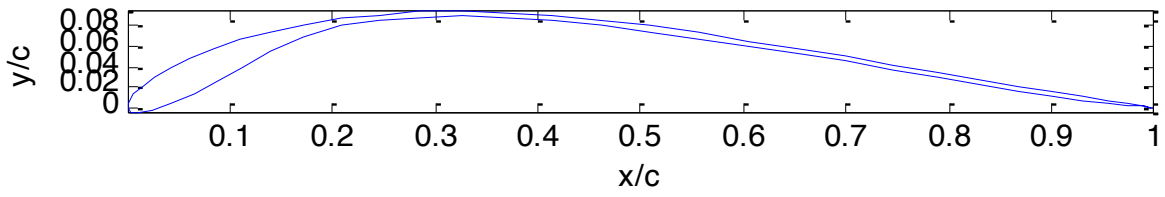
```
clear all;
%>>>>>Roncz 1080 Airfoil
x=[1    0.99    0.979999    0.959998    0.939998    0.919997    0.899996    0.879995    0.859994    0.8
y=[0    0.002591    0.005338    0.010402    0.015068    0.019713    0.02442 0.029202    0.034056    0.0
z=x+i*y;npanels=length(z);k=npanels;alpha=[-15:15]*pi/180;

for nn=1:length(alpha)
    winf=exp(-i*alpha(nn));
    %<<<<<
    a=[1:npanels];b=[2:npanels 1];c=[3:npanels 1 2];
    dzds=(z(b)-z(a))./abs(z(b)-z(a));

    eps=0.0001;
    zc=(z(a)+z(b))/2-i*eps*(z(b)-z(a)); %control points

    cm=zeros(npanels);
    for m=1:npanels
    cm(:,m)=-i*(((zc(m)-z(a))./(z(b)-z(a)).*log((zc(m)-z(a))./(zc(m)-z(b)))-1)./dzds(a)/2/pi...
                -((zc(m)-z(c))./(z(b)-z(c)).*log((zc(m)-z(c))./(zc(m)-z(b)))-1)./dzds(b)/2/pi)*dzds(m);
    end
    res=imag(-winf*dzds);
    cm1=imag(cm);cm1(:,end)=0;cm1(k,end)=1;
    res(end)=0;
    q=res/cm1;

    ut=real(q*cm+winf*dzds);
    cp=1-ut.^2/abs(winf).^2;
    %>>>>>
    [illegible]=sum(cp.*(real(zc)-0.25).*real(z(b)-z(a))+cp.*imag(zc).*imag(z(b)-z(a)));
    cy(nn)=sum(real(z(b)-z(a)).*(cp));
    cx(nn)=sum(imag(z(b)-z(a)).*(cp));

end
 cl = cy.*cos(alpha) - cx.*sin(alpha);
 figure
plot(alpha*180/pi,cl,'ro');
title('Roncz 180');xlabel('\alpha (deg)');ylabel('C_l');
fontsize(14,"points");
%<<<<<
```

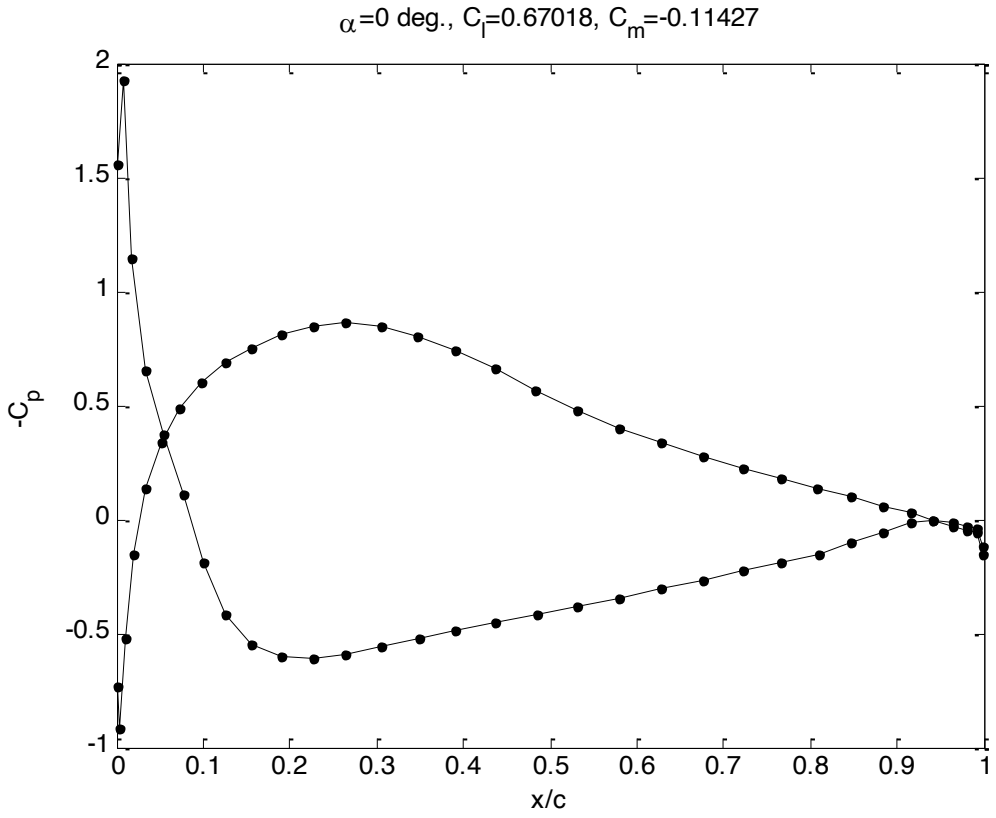


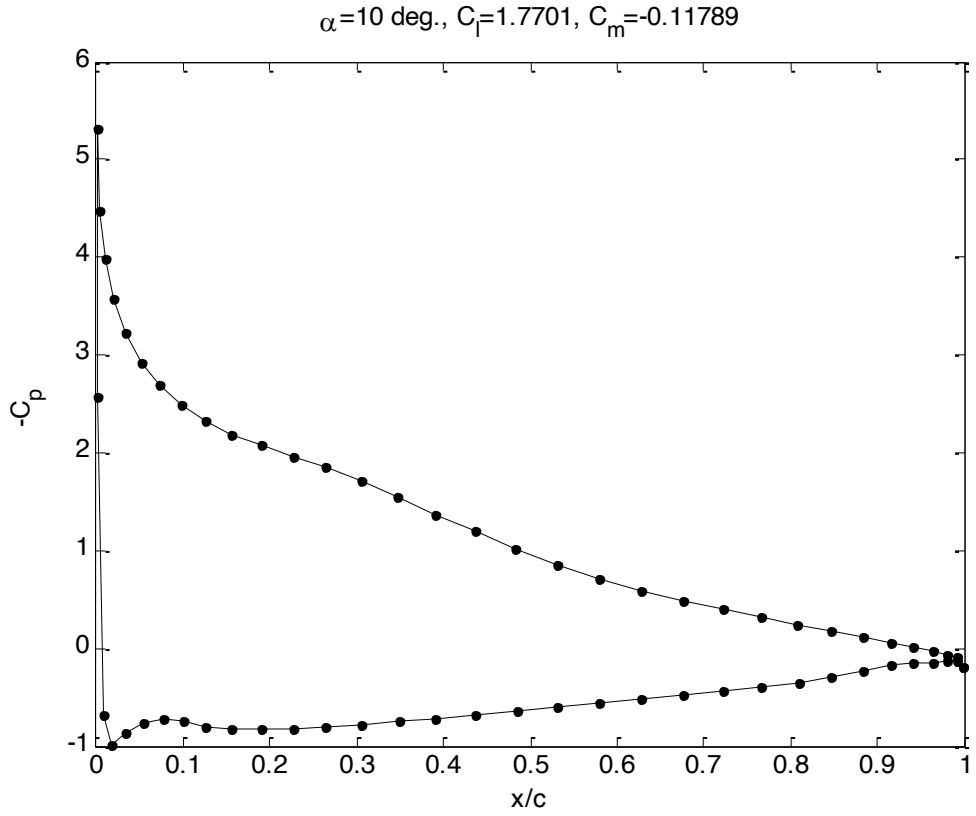
2(a).

Code (changes from Canvas version are lines between %>>> and %<<< markers):

```
clear all;
%>>>Modified Eppler 377 Airfoil
x=[1     0.9971  0.98841 0.97407 0.95434 0.92957 0.90015 0.8665  0.82909 0.78841 0.74501 0.69944 0.65229 0.
y=[0     0.0004  0.00159 0.00363 0.00664 0.0106  0.01545 0.02112 0.02751 0.03449 0.04193 0.04966 0.05751 0.
z=x+i*y;figure;plot(z);axis image;xlabel('x/c');ylabel('y/c');
alpha=10*pi/180;winf=exp(-i*alpha);
npanels=length(z);k=npanels;
a=[1:npanels];b=[2:npanels 1];c=[3:npanels 1 2];
%<<<<

dzds=(z(b)-z(a))./abs(z(b)-z(a));

eps=0.0001;
zc=(z(a)+z(b))/2-i*eps*(z(b)-z(a)); %control points

cm=zeros(npanels);
for m=1:npanels
cm(:,m)=-i*(((zc(m)-z(a))./(z(b)-z(a)).*log((zc(m)-z(a))./(zc(m)-z(b)))-1)./dzds(a)/2/pi...
          -((zc(m)-z(c))./(z(b)-z(c)).*log((zc(m)-z(c))./(zc(m)-z(b)))-1)./dzds(b)/2/pi)*dzds(m);
end
res=imag(-winf*dzds);
cm1=imag(cm);cm1(:,end)=0;cm1(k,end)=1;
res(end)=0;
q=res/cm1;

ut=real(q*cm+winf*dzds);
cp=1-ut.^2/abs(winf).^2;
figure
%>>>
plot(real(zc),-cp,'k.-');xlabel('x/c');ylabel('-C_p');title(['\alpha=' num2str(alpha*180/pi) ' deg.']);
%<<<
```



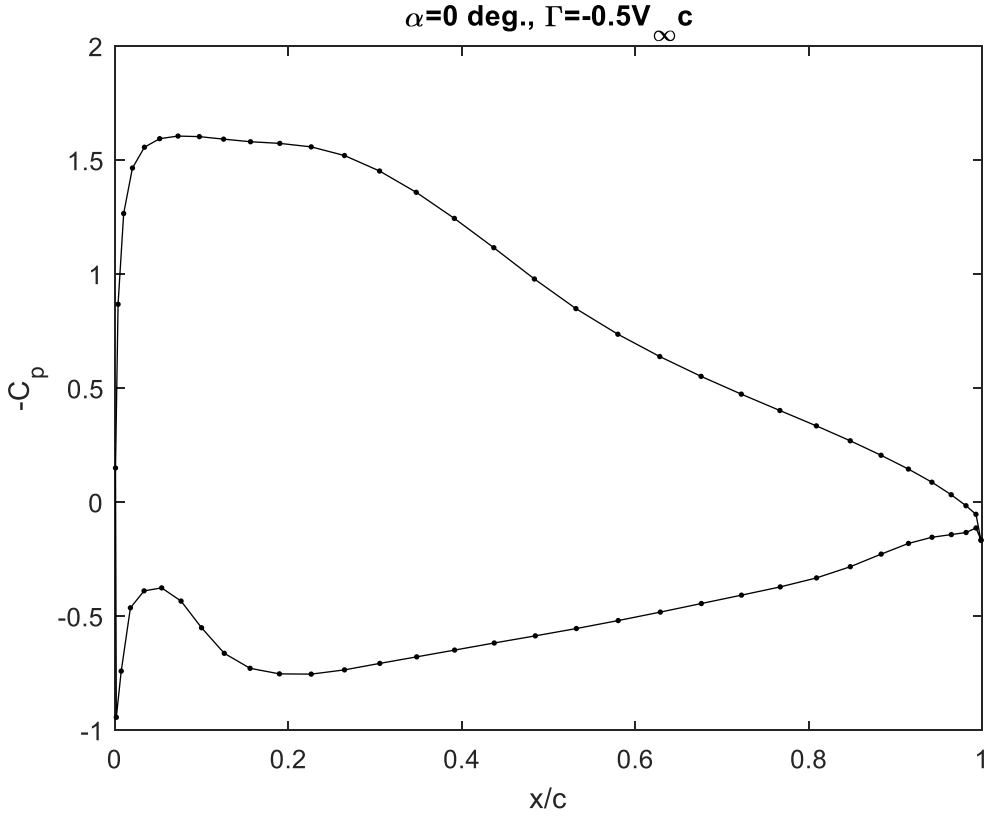

α=0 deg., C_l=0.67018, C_m=-0.11427
-C_p
x/c
2
1.5
1
0.5
0
-0.5
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

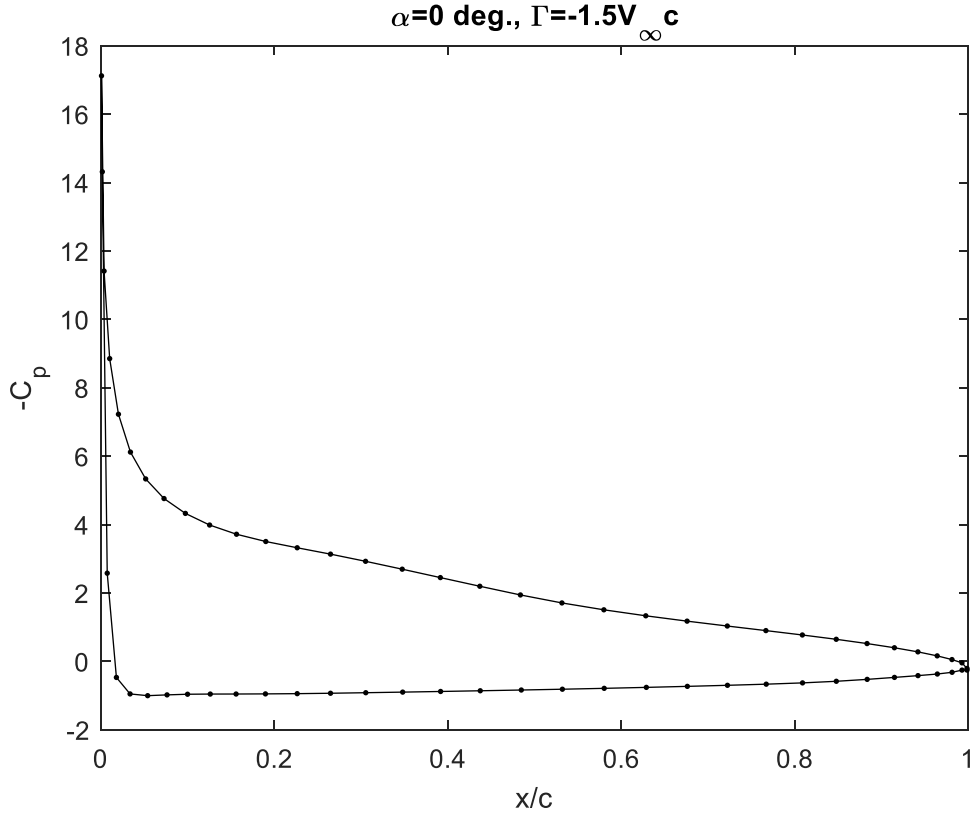

α=10 deg., C_l=1.7701, C_m=-0.11789
-C_p
x/c
6
5
4
3
2
1
0
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

2(b)

Code (changes from class website version are lines between %>>> and %<<< markers):

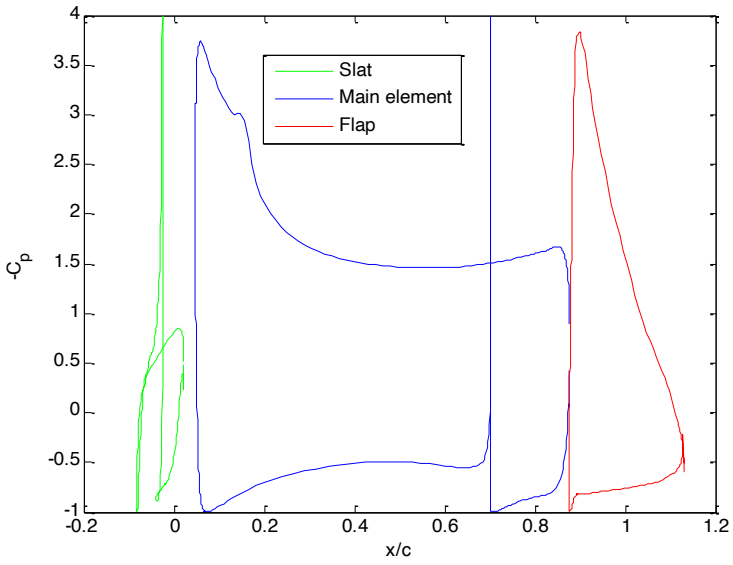
```
clear all;
%>>>Modified Eppler 377 Airfoil
x=[1    0.9971  0.98841 0.97407 0.95434 0.92957 0.90015 0.8665  0.82909
y=[0    0.0004  0.00159 0.00363 0.00664 0.0106  0.01545 0.02112 0.02751
z=x+i*y;figure;plot(z);axis image;xlabel('x/c');ylabel('y/c');
alpha=0*pi/180;
npanels=length(z);k=npanels;
a=[1:npanels];b=[2:npanels 1];c=[3:npanels 1 2];
%<<<<

dzds=(z(b)-z(a))./abs(z(b)-z(a));

eps=0.0001;
zc=(z(a)+z(b))/2-i*eps*(z(b)-z(a)); %control points
%>>>
gamma=-0.5;
winf=exp(-i*alpha)-i*gamma/2/pi./(zc-1.5);
%<<<

cm=zeros(npanels);
for m=1:npanels
cm(:,m)=-i*(((zc(m)-z(a))./(z(b)-z(a)).*log((zc(m)-z(a))./(zc(m)-z(b)))-
1)./dzds(a)/2/pi...
          -((zc(m)-z(c))./(z(b)-z(c)).*log((zc(m)-z(c))./(zc(m)-z(b)))-
1)./dzds(b)/2/pi)*dzds(m);
end
%>>>
res=imag(-winf.*dzds);
%>>>
cm1=imag(cm);cm1(:,end)=0;cm1(k,end)=1;
res(end)=0;
q=res/cm1;

ut=real(q*cm+winf.*dzds);
%>>>
cp=1-ut.^2/1;
figure
plot(real(zc),-cp,'k.-');xlabel('x/c');ylabel('-C_p');title(['\alpha='
num2str(alpha*180/pi) ' deg., \Gamma=' num2str(gamma) 'V_\inftyc']);
%<<<
```

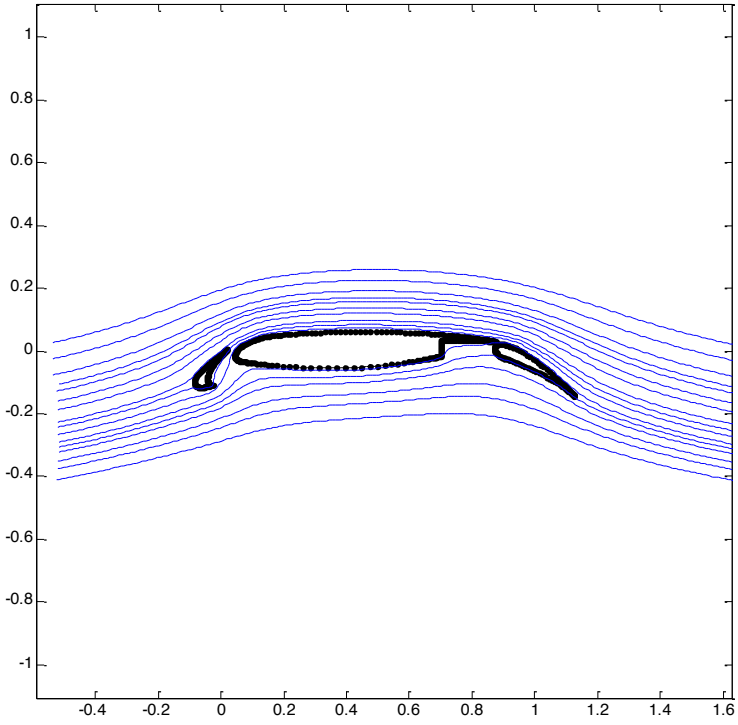

α=0 deg., Γ=-0.5V_∞c
-C_p
x/c
2
1.5
1
0.5
0
-0.5
-1
0
0.2
0.4
0.6
0.8
1


α=0 deg., Γ=-1.5V_∞c
-C_p
x/c
18
16
14
12
10
8
6
4
2
0
-2
0
0.2
0.4
0.6
0.8
1

3.

```
clear all;
%>>>>30P30N multi-element airfoil
load('threeElementAirfoil.mat');
z=[zslat zmain zflap];
npanels1=length(zslat);npanels2=length([zslat zmain]);
npanels=length(z);
alpha=0;winf=exp(-alpha/180*pi*i);
k1=npanels1;k2=npanels2;k3=npanels;
a=[1:npanels];
b=[2:npanels1 1 npanels1+2:npanels2 npanels1+1 npanels2+2:npanels npanels2+1];
c=[3:npanels1 1 2 npanels1+3:npanels2 npanels1+1 npanels1+2 npanels2+3:npanels
npanels2+1 npanels2+3];
%<<<<<<
dzds=(z(b)-z(a))./abs(z(b)-z(a));

eps=0.0001;
zc=(z(a)+z(b))/2-i*eps*(z(b)-z(a)); %control points

cm=zeros(npanels);
for m=1:npanels
cm(:,m)=-i*(((zc(m)-z(a))./(z(b)-z(a)).*log((zc(m)-z(a))./(zc(m)-z(b)))-
1)./dzds(a)/2/pi...
           -((zc(m)-z(c))./(z(b)-z(c)).*log((zc(m)-z(c))./(zc(m)-z(b)))-
1)./dzds(b)/2/pi)*dzds(m);
end
res=imag(-winf*dzds);
cm1=imag(cm);
%>>>>
cm1(:,npanels1)=0;cm1(k1,npanels1)=1;res(npanels1)=0;
cm1(:,npanels2)=0;cm1(k2,npanels2)=1;res(npanels2)=0;
cm1(:,end)=0;cm1(k3,end)=1;res(end)=0;
%<<<<
q=res/cm1;

ut=real(q*cm+winf*dzds);
cp=1-ut.^2/abs(winf).^2;
figure
%>>>>
plot(real(zc(1:npanels1)),-cp(1:npanels1),'g',real(zc(npanels1+1:npanels2)),-
cp(npanels1+1:npanels2),'b',real(zc(npanels2+1:npanels)),-
cp(npanels2+1:npanels),'r');
ylim([-1,4]);xlabel('x/c');ylabel('-C_p');legend('Slat','Main element','Flap');
%<<<<
```


Slat
Main element
Flap
-Cp
x/c
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-0.2
0
0.2
0.4
0.6
0.8
1
1.2


1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6