Cairo University
Faculty of Engineering
Aerospace Engineering Dept.

Report (2)
AER 3110 - Aerodynamics
3rd Year, 1st Semster 2021/2022

Lab Report 2

By:

Submitted to:

Mohammad Khaled Gamal Ali

Eng.Karim Ahmed

Table of Contents

```
% Mohammad Khaled Gamal Ali / sec:2 / B.N:50
% LAB Assignment / Submitted to: Eng.Karim Ahmed
clear all
clc
```

Input data x

```
x_Lower=[1.00000,  0.99000,  0.98000,  0.96672,  0.94908,  0.92565,
 0.89453,  0.85321,  0.79832,  0.72542,  0.62860,  0.50000,  0.37855,
 0.28653,  0.21680,  0.16397,  0.12394,  0.09360,  0.07061,  0.05320,
 0.04000,  0.03000,  0.02000,  0.01000,  0.00000];
x_Upper=[0.00000,  0.01000,  0.02000,  0.03000,  0.04000,  0.05320,
 0.07061,  0.09360,  0.12394,  0.16397,  0.21680,  0.28653,  0.37855,
 0.50000,  0.62860,  0.72542,  0.79832,  0.85321,  0.89453,  0.92565,
 0.94908,  0.96672,  0.98000,  0.99000,  1.00000];
x = [x_Lower, x_Upper];
```

Y from the x data

```
y_Upper=
+0.594689181*(0.298222773*sqrt(x_Upper)-0.127125232*x_Upper-0.357907906*x_Upper.^2
y_Lower=-0.594689181*(0.298222773*sqrt(x_Lower)-0.127125232*x_Lower-0.357907906*x_
y = [y_Lower, y_Upper];
```

Input data Cp

```
Cp_Upper= [-0.83000,  0.53900,  0.80000,  0.99470,  1.05000,  1.07000,
  1.05560,  1.04170,  0.98080,  0.89740,  0.79500,  0.67130,  0.54330,
  0.38950,  0.24340,  0.15300,  0.08340,  0.01400, -0.04860, -0.09040,
 -0.15990, -0.20170, -0.26430, -0.35600, -0.4000];
Cp_Lower= [-0.40000, -0.35510, -0.27826, -0.22260, -0.18087, -0.13913,
 -0.09739, -0.04350,  0.00695,  0.04174,  0.11130,  0.18080,  0.23650,
  0.27100,  0.28500,  0.26440,  0.23650,  0.17390,  0.09040,  0.00000,
 -0.12520, -0.18000, -0.31650, -0.51130, -0.83000];
Cp=[Cp_Lower, Cp_Upper];
```

A.O.A.

```
a=2;
```

I.C. at point x(i+0.5) where i+0.5 is the midpoint of i and i+1

```
C=1;
C_Normal=0;
C_Axial=0;
Cm=0;
```

Calculations of normal and axial forces

```
for n = 1:length(x)-1

delta_xi = x(n+1)-x(n);
delta_yi = y(n+1)-y(n);

xi_Mid_Point = 0.5*(x(n)+x(n+1));
yi_Mid_Point = 0.5*(y(n)+y(n+1));
Cpi_Mid_Point = 0.5*(Cp(n)+Cp(n+1));

C_Normal =C_Normal  + Cpi_Mid_Point * delta_xi;
C_Axial =C_Axial  -Cpi_Mid_Point * delta_yi;

Cm =Cm + ( -(Cpi_Mid_Point * delta_xi)*xi_Mid_Point -(Cpi_Mid_Point *
 delta_yi)*yi_Mid_Point );

end
```

getting CL,CD and Cm from the normal and axial forces

```
CL = C_Normal*cos(a*pi/180) - C_Axial*sin(a*pi/180);
CD = C_Axial*cos(a*pi/180) - C_Normal*sin(a*pi/180);
```

Printing the Values of CL,CD,Cm

```
disp('CL=')
disp(CL)
disp('CD=')
disp(CD)
disp('Cm=')
disp(Cm)

CL=
    0.3205
```
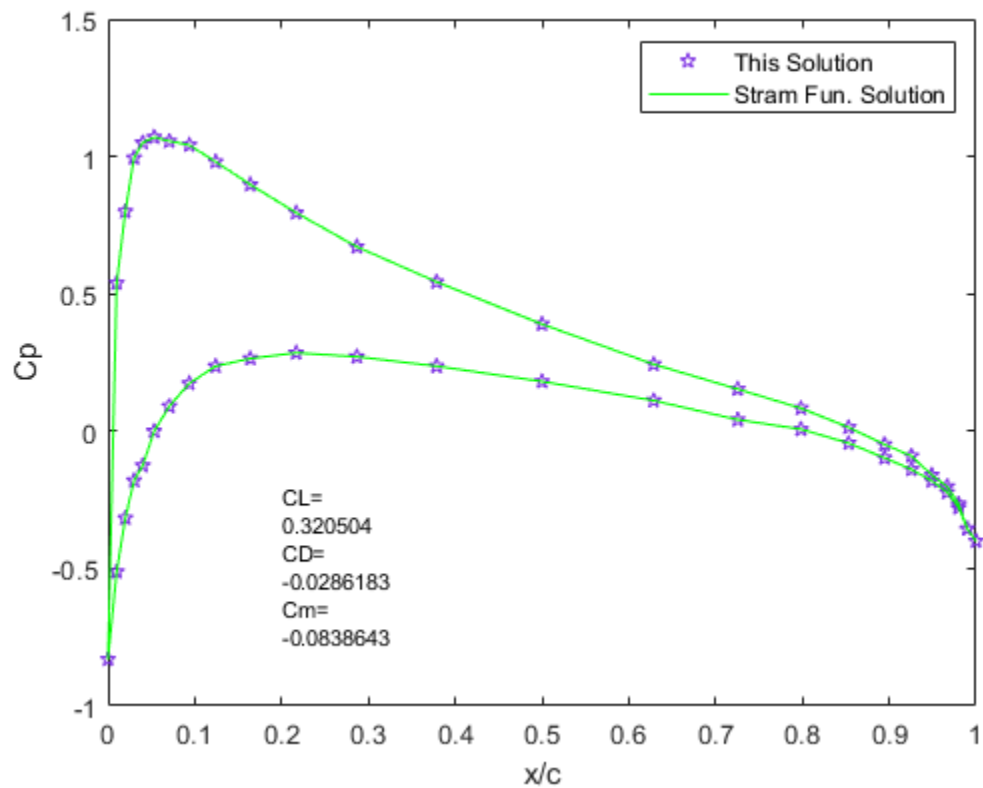
```
CD=
   -0.0286

Cm=
   -0.0839
```

Plotting of the X/c vs Cp

```matlab
plot(x/C,Cp,'p','Color',[0.5,0.2,0.9])
hold on
plot(x/C,Cp,'g')
xlabel('x/c')
ylabel('Cp')
legend( "This Solution","Stram Fun. Solution" )
str = {'CL=',CL,'CD=',CD,'Cm=',Cm};

text(0.2,-0.5,str,'FontSize',8)
```

	x	Cp	y		x	Cp	y
1	1	-0.4	1.65E-17	25	0	-0.83	0
2	0.99	-0.3551	-0.00141	26	0.01	0.539	0.016958
3	0.98	-0.27826	-0.0028	27	0.02	0.8	0.023485
4	0.96672	-0.2226	-0.00463	28	0.03	0.9947	0.028263
5	0.94908	-0.18087	-0.007	29	0.04	1.05	0.032116
6	0.92565	-0.13913	-0.01008	30	0.0532	1.07	0.036307
7	0.89453	-0.09739	-0.01404	31	0.07061	1.0556	0.040787
8	0.85321	-0.0435	-0.01907	32	0.0936	1.0417	0.045455
9	0.79832	0.00695	-0.0254	33	0.12394	0.9808	0.050113
10	0.72542	0.04174	-0.03317	34	0.16397	0.8974	0.054416
11	0.6286	0.1113	-0.04235	35	0.2168	0.795	0.057814
12	0.5	0.1808	-0.05219	36	0.28653	0.6713	0.05946
13	0.37855	0.2365	-0.05813	37	0.37855	0.5433	0.058133
14	0.28653	0.271	-0.05946	38	0.5	0.3895	0.05219
15	0.2168	0.285	-0.05781	39	0.6286	0.2434	0.04235
16	0.16397	0.2644	-0.05442	40	0.72542	0.153	0.033169
17	0.12394	0.2365	-0.05011	41	0.79832	0.0834	0.025399
18	0.0936	0.1739	-0.04546	42	0.85321	0.014	0.019075
19	0.07061	0.0904	-0.04079	43	0.89453	-0.0486	0.014038
20	0.0532	0	-0.03631	44	0.92565	-0.0904	0.010079
21	0.04	-0.1252	-0.03212	45	0.94908	-0.1599	0.007001
22	0.03	-0.18	-0.02826	46	0.96672	-0.2017	0.004625
23	0.02	-0.3165	-0.02349	47	0.98	-0.2643	0.002802
24	0.01	-0.5113	-0.01696	48	0.99	-0.356	0.00141
25	0	-0.83	0	49	1	-0.4	-1.65E-17