% House Cleaning

clc

close all

clear vars

% Read in NACA Data

naca\_data = readmatrix('ClarkY14\_NACA\_TR628.xlsx');

naca\_aoa = naca\_data(:,1);

naca\_c\_l = naca\_data(:,2);

naca\_c\_d = naca\_data(:,3);

% Read in Port Locations

x = readmatrix('ClarkY14\_PortLocations.xlsx');

x(10,:)= []; % Remove NaN row

y\_loc\_inf = x(:,3); % Port Locations -- y-axis

z\_loc\_inf = x(:,4); % z-axis

% Add in

y\_loc\_inf1 = [y\_loc\_inf(end);y\_loc\_inf(1:9);1;y\_loc\_inf(10:end)];

z\_loc\_inf1 = [z\_loc\_inf(end);z\_loc\_inf(1:9);0;z\_loc\_inf(10:end)];

chord\_l = 3.5031; % Chord length of wing

yc = y\_loc\_inf/chord\_l; % Normalize the chord length

yc\_new = [yc(end);yc(1:9);1;yc(10:end)]; % Add in chord length for interpolated data and to close the area

% c\_p Function Call

c\_p\_inf\_1 = calculate\_c\_p(yc,10,'ASEN2802\_InfiniteWing\_FullRange.csv');

c\_p\_inf\_2 = calculate\_c\_p(yc,9,'ASEN2802\_InfiniteWing\_FullRange.csv');

c\_p\_inf\_3 = calculate\_c\_p(yc,6,'ASEN2802\_InfiniteWing\_FullRange.csv');

% Preallocate c\_l and c\_d Vectors

c\_l = zeros(1,length(c\_p\_inf\_1));

c\_d = zeros(1,length(c\_p\_inf\_1));

% Vector of Angles of Attack

aoa1 = (-15:1:16);

% For Loop to Calculate c\_l and c\_d for Every Angle Of Attack

for i = 1:length(aoa1)

[c\_l(i),c\_d(i)] = calculate\_c\_l\_d(y\_loc\_inf1,z\_loc\_inf1,yc,chord\_l,aoa1(i),'ASEN2802\_InfiniteWing\_FullRange.csv');

end

% Find Angle of Attack for Highest c\_l

[max\_c\_l,max\_index] = max(c\_l);

aoa\_max = aoa1(max\_index);

% Find C\_l for a 10 degree Angle of Attack for Structures Team

c\_l\_10 = c\_l(26);

fprintf('For a 10 degree angle of attack, c\_l = %4.4f',c\_l\_10)

% Plot Data

% c\_p vs x/c Plot

figure(1);

plot(yc\_new,c\_p\_inf\_1,'.-r')

hold on

plot(yc\_new,c\_p\_inf\_2,'.-k')

plot(yc\_new,c\_p\_inf\_3,'.-b')

xlabel('Normalized Chord Length')

ylabel('Pressure Coefficient')

title('Pressure Distribution Around a Clark Y-14 Airfoil at Various Angles of Attack')

grid on

legend('10^o','9^o','6^o')

set(gca,'YDir','reverse')

% c\_l vs Angle of Attack Plot

figure(2);

subplot(1,2,1)

plot(aoa1,c\_l,'.-b')

hold on

plot(naca\_aoa,naca\_c\_l,'.-r')

grid on

title('Coefficient of Lift Around a Clark Y-14 Airfoil at Various Angles of Attack')

ylabel('c\_l')

ylim([-0.5 2])

xlabel('Angles of Attack [^o]')

legend('c\_l Values','NACA c\_l Values','Location','northwest')

% c\_d vs Angle of Attack Plot

subplot(1,2,2)

plot(aoa1,c\_d,'.-')

hold on

plot(naca\_aoa,naca\_c\_d,'.-r')

grid on

title('Coefficient of Drag Around a Clark Y-14 Airfoil at Various Angles of Attack')

ylabel('c\_d')

xlabel('Angles of Attack [^o]')

legend('c\_d Values','NACA c\_d Values','Location','northwest')

function c\_p = calculate\_c\_p(l,aoa,filename)

inf\_data = load(filename);

logical\_aoa = inf\_data(:,8) == aoa; % Uses data corresponding to aoa

inf\_data\_aoa = inf\_data(logical\_aoa,:);

rho\_inf = inf\_data\_aoa(:,3); % Free-stream density

V\_inf = inf\_data\_aoa(:,4); % Free-stream airspeed

dynamic\_inf = 0.5 .\* rho\_inf .\* V\_inf .^2;

delta\_P\_inf = inf\_data\_aoa(:,15:30);

% Interpolate for Trailing Edge

delta\_P89 = delta\_P\_inf(:,8) + (1-l(8))/(l(9)-l(8)) \* (delta\_P\_inf(:,9)-delta\_P\_inf(:,8));

delta\_P1011 = delta\_P\_inf(:,10) + (1-l(10))/(l(11)-l(10)) \* (delta\_P\_inf(:,11)-delta\_P\_inf(:,10));

delta\_P\_ave = (delta\_P89 + delta\_P1011)/2; % Average both pressure readings

% Calculate c\_p values

c\_p = delta\_P\_inf ./ dynamic\_inf;

c\_p\_TE = delta\_P\_ave ./ dynamic\_inf; % Trailing Edge

c\_p = [c\_p(:,1:9),c\_p\_TE,c\_p(:,10:end)]; % Add in interpolated data

c\_p = mean(c\_p); % Average the values

c\_p = [c\_p(end),c\_p]; % Close the loop

end

function [c\_l,c\_d] = calculate\_c\_l\_d(y,z,l,chord,aoa,filename)

% c\_p Function Call

c\_p1 = calculate\_c\_p(l,aoa,filename);

% Integration Using trapz()

c\_n = -1/chord \* trapz(y,c\_p1); % Normal

c\_a = 1/chord \* trapz(z,c\_p1); % Axial

% Compute c\_l and c\_d

c\_l = c\_n \* cosd(aoa) - c\_a \* sind(aoa);

c\_d = c\_n \* sind(aoa) + c\_a \* cosd(aoa);

end