Intro to Code

I chose to model the wing with a thickness of 10 meters and a chord length of 2 meters and a 2 deg half angle with sharp edges. The way I chose to set up this problem is to use matlab to code up 3 loops for altitude, mach number, and attack angle. I did not make any subroutines, however, if I use this code in the future I would make the code that solves for pressure in every zone of the wing a subroutine. Here is an outline of my strategy:

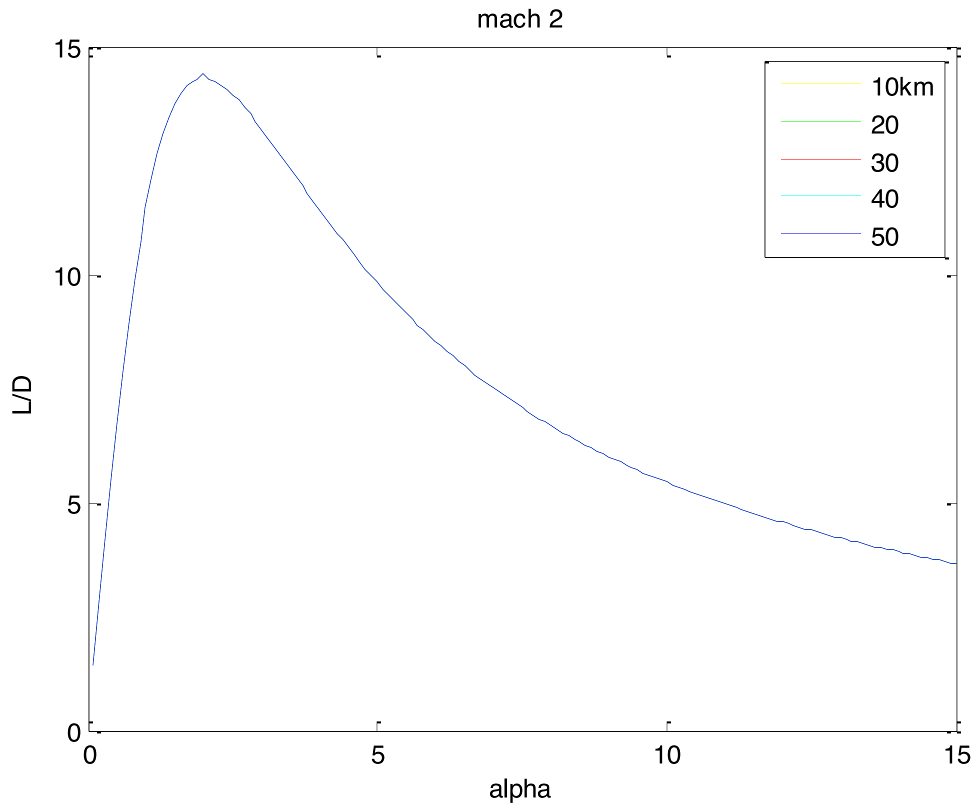
Loop for altitude

- *Loop for mach number*
  - Loop for attack angle
    - Calculate pressures on all sides of wing
    - Calculate L/D for all angles
    - Calculate corrections if needed
  - End attack angle loop
  - Calculate L/D max for the current Mach number
- *End mach number loop*

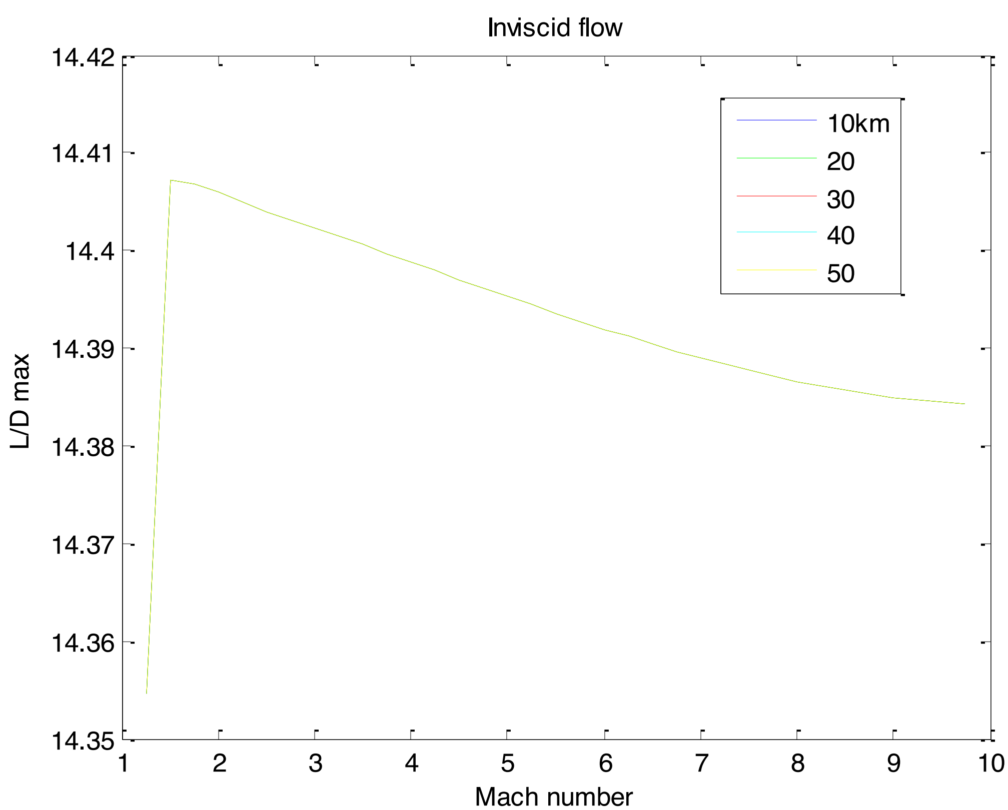
End altitude loop

Create graphs

Part 2 Inviscid flow



There is no effect for altitude because we are assuing inviscid flow.



Matlab code

```
clc
clear all
close all
for k=1:5   %loop for altitudes
for j=1:35  %loop for different mach numbers
%pressure values at 10 km, 20, 30, 40 and 50
P(1)=2.650E+4;
P(2)=5.529E+3;
P(3)=1.197E+3;
P(4)= 2.871E+2;
P(5)=7.977E+1;


    P_inf=P(k);
    delta=5;
    gamma=1.4;
    alpha=6;
    M_inf=1.1+.25*j;
for i=1:150  % different values for alpha

    alpha(i)=.1*i;

%{
P2=1.7066;
P3=1;
P4=1.0026;
P5=.548;
%}

%solve for Pressures on top of wing (zones 3 and 5)
if delta > alpha(i)    %if delta<alpha then it is an oblique shock
tan_Beta  =Oblique_shock_solve_explicit(gamma,(delta-alpha(i))*pi/180, M_inf,1);
Beta=atan(tan_Beta)*180/pi;
%equations for normal mach number across the shock(see section 6.1 slides)


term5=(1+(gamma-1)/2*(M_inf*sind(Beta))^2);
term6= (  gamma*( M_inf*sind(Beta)  )^2 - (gamma-1)/2  );
Mn_inf=sqrt(term5/term6);
M3=Mn_inf/sin(Beta*pi/180-(delta-alpha(i))*pi/180);
P3=P_inf*(1+2*gamma/(gamma+1)*((M_inf*sind(Beta))^2-1));

else  %if delta>alpha then it is an expansion
    %mach number in area 3 and pressure for expansion
   % if delta-alpha(i)=0
    M3  =PM_function_solve(gamma,abs((delta-alpha(i))/180*pi), M_inf);
    term3=1+(gamma-1)/2*M_inf^2;
    %isentropic expansion so P01=P03
    P0=P_inf*term3^(gamma/(gamma-1));
    P3=P0/(1+(gamma-1)/2*M3^2)^(gamma/(gamma-1));
end

M5  =PM_function_solve(gamma,2*delta/180*pi, M3);
term1=1+(gamma-1)/2*M3^2;
term2=1+(gamma-1)/2*M5^2;
P5=P3*(term1/term2)^(gamma/(gamma-1));

%solve for pressures on botton of wing(zones 2 and 4)
tan_Beta  =Oblique_shock_solve_explicit(gamma,(delta+alpha(i))*pi/180, M_inf,1);
Beta=atan(tan_Beta)*180/pi;
```

```
%equations for normal mach number (see section 6.1 slides)

term5=(1+(gamma-1)/2*(M_inf*sind(Beta))^2);
term6= (  gamma*( M_inf*sind(Beta)  )^2 - (gamma-1)/2  );
Mn2=sqrt(term5/term6);
M2=Mn2/sin(Beta*pi/180-(delta+alpha(i))*pi/180);
if M2 <1
    break
end
M4  =PM_function_solve(gamma,2*delta/180*pi, M2) ;

P2=P_inf*(1+2*gamma/(gamma+1)*((M_inf*sind(Beta))^2-1));
term1=1+(gamma-1)/2*M2^2;
term2=1+(gamma-1)/2*M4^2;
P4=P2*(term1/term2)^(gamma/(gamma-1));



%this code will find CD, CL, and L/D for different alphas

const1=1/( 2*cosd(delta) )*1/(gamma/2*M_inf^2);
term1=P2/P_inf-P5/P_inf;
term2=P3/P_inf-P4/P_inf;
term3=P4/P_inf-P3/P_inf;

[C]=const1* [term1*sind(delta+alpha(i)) + term2*sind(delta-alpha(i)), ...
             term1*cosd(delta+alpha(i)) + term3*cosd(delta-alpha(i)) ];
CD(i)=C(1);
CL(i)=C(2);

L_over_D(i,j,k)=CL(i)/CD(i);

end     %end of i loop
Mach_number(j)=M_inf;
L_over_D_max(j,k)=max(L_over_D(:,j,k));
%
%}
end     % end of j loop
end     %end of k loop
figure(1)
plot(alpha(1:max(size(L_over_D))),L_over_D(:,4,1),'y');hold on;
plot(alpha(1:max(size(L_over_D))),L_over_D(:,4,2),'g');hold on;
plot(alpha(1:max(size(L_over_D))),L_over_D(:,4,3),'r');hold on;
plot(alpha(1:max(size(L_over_D))),L_over_D(:,4,4),'c');hold on;
plot(alpha(1:max(size(L_over_D))),L_over_D(:,4,5),'b');hold on;
xlabel('alpha');
ylabel('L/D ')
legend('10km','20','30','40','50')
title('mach 2');

figure(111)
plot(Mach_number(1,:),L_over_D_max(:,1),'b');hold on;
plot(Mach_number(1,:),L_over_D_max(:,2),'g');hold on;
plot(Mach_number(1,:),L_over_D_max(:,3),'r');hold on;
plot(Mach_number(1,:),L_over_D_max(:,4),'c');hold on;
plot(Mach_number(1,:),L_over_D_max(:,5),'y');hold on;
xlabel('Mach number');
ylabel('L/D max')
legend('10km','20','30','40','50')
title('Inviscid flow');
```