Yue Jiao

911024-7799

Declaration

**Here I promise that the whole assignment is done   
by myself alone without help from others.**

Fundamentals of Flight

Assignment 5

**Problem 1:**

1. We have an expression for aerofoil section.

We want to calculate the ideal angle of attack . This is given by the following expression.

So, we will have the following.

Then the ideal angle of attack can be expressed as the following.

So

1. The zero-lift angle of attack is given by:

So

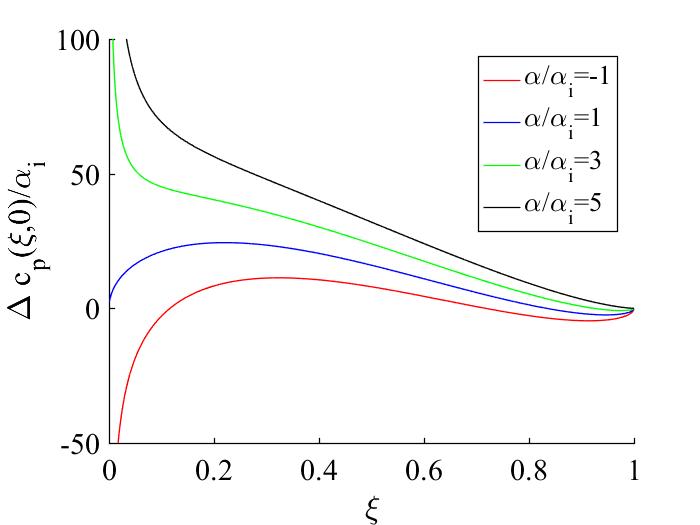
1. If the maximum relative camber is ,
2. With the potential theory for thin aerofoil section, we have the following equations.

So and

We can write so can be expressed as a sum of the integral for different and . From Fourier analysis, we know this integral has a simple solution as follow.

Thus, we can calculate the values for all .

We also know that so can be replaced by .



We can see that the ratio increases with the increasing ratio . We can also see that all of them ending at which is exactly the Kutta condition.

**Problem 2:**

This problem can be solved with the horse-shoe model. We assume that we are calculating the downsweep at the location and apply Biot-Savart law to it. We also need to assume that the angles between the y-axel and the line formed by connecting wingtips and are both since the symmetry property and the angles between this line and the longitudinal horse-shoe line are and where and . So, we will have the following relationship.

**Problem 3:**

1. The lift coefficient is defined as the following.

According to the Kutta-Joukowski theorem:

Since we are having a non-elliptic load distribution, so we will have the following equations.

By Fourier analysis we know that . So, we have:

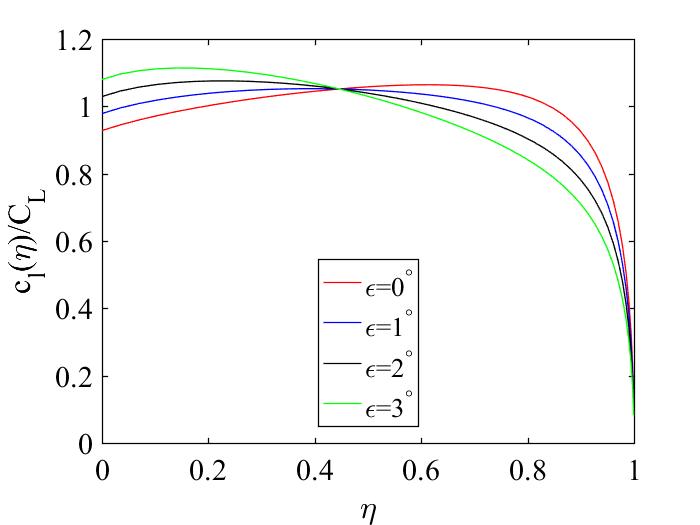
We know from the lifting-line theory, that:

So, the total lift coefficient shall be:

1. In this problem, we have . We have a indata which gives that and . So, for each , we have the following table.

|  |  |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

1. We know that and . So, we have the following.



1. The maximums are calculated with Matlab and given here below.

|  |  |  |
| --- | --- | --- |
|  | Position |  |
|  | 0.6157 | 1.0641 |
|  | 0.4067 |  |
|  | 0.2419 |  |
|  | 0.1392 |  |

1. We can see that the maximum increases with and the position of the maximum move toward the root. All of the lines meet at the same point as well.