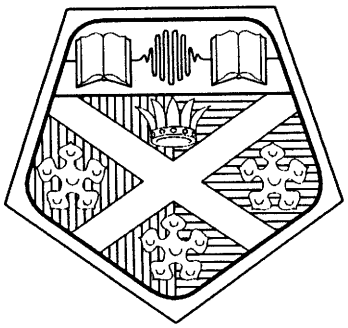

ME529 Aerodynamics in C – Coursework #2 Report

Jacob Currie - 201718558

Date: 01/04/22

ABSTRACT

In this report, the testing of the lifting line theory calculator software written for coursework 2 of ME529, is described and presented, with conclusions of the results drawn and summarised. The input testing data is listed as well as the expected and acquired results of lift and drag coefficient. The report concludes that the software produces accurate results with a very small deviation from what was expected, either as a result of the lifting line theory approximation or the number of distance sample wings across the hypothetical wing.

1 INTRODUCTION

This report describes the testing and validation of the software written for coursework 2 of ME529 – Aerodynamics in C. In order to test the program, the sets of input testing data provided were used, and are shown below in table. As the lift and drag coefficients calculated are derived from the 'A' coefficients of the Fourier series, any incorrectness in the series would cascade through the calculation of the lift and drag coefficients, so there is no need to include the Fourier series information in testing as it is tested by proxy. Datasets 1 to 3 are drawn from the coursework specification provided[1].

Table 1 - Testing Input Data

Dataset	Wing Span	Root Chord	Taper Ratio	Lift Curve Slope	Zero-Lift Angle	Washout	Angle of Attack
#1	9	1.5	1	5.93	0	0	4
#2	9	1.5	0.6	5.93	0	0	4
#3	9	1.5	1	5.93	0	2	4

2 RESULTS OF TESTING

Below in table 2 the correct expect lift and drag coefficients for the above testing data sets, as well as the calculate result coefficients from the written software, are listed.

Table 2 - Testing Output Data

Dataset	#1	#2	#3
Expected Lift Coefficient (CL)	0.3025	0.3266	0.2363
Result Lift Coefficient (CL)	0.3013	0.3211	0.2304
Expected Drag Coefficient (CD)	0.0051	0.0046	0.0030
Result Drag Coefficient (CD)	0.0050	0.0044	0.0028

3 CONCLUSION

Observing the results in table 2 above, it is clear that the lifting line theory gives a very good approximation for the given test data, with the results almost coinciding exactly, with a general trend of underprediction in both the lift and drag coefficients. This may be due to the number of sampling distances chosen across the wing, similar to the number of points used in the numerical integration scheme used to solve for results using thin aerofoil theory. Increasing the number of points sampled across the distance of the wing may improve the accuracy of the results, this may be considered further work, alongside the addition of the variability of this sampling point parameter. The number of decimal places in the results as not enough to draw any conclusions about the influence of floating-point precision in the software, and it is highly unlikely to be an issue regardless.

The software was tested against the lifting line software[2] given in the class resources, with the results agreeing, showing that the implementation of the mathematical methods was correct.

In summary, the results show high accuracy with slight deviation due to either the lifting line theory approximation or the number of sample points across the wing.

4 REFERENCES

[1] D. M. Stickland, “ME529 Coursework 2 Specification.” University of Strathclyde - MyPlace, 2022, [Online]. Available: https://classes.myplace.strath.ac.uk/mod/resource/view.php?id=800957.

[2] D. M. Stickland, “Lifting Line Example Program.” University of Strathclyde - MyPlace, 2022, [Online]. Available: https://classes.myplace.strath.ac.uk/mod/resource/view.php?id=800958.