

Numerical Methods (MAT 370) - Integration

James Pack

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1 Introduction

Designing and producing new aircraft requires great attention to detail to ensure the aircraft can safely take flight. One of the important details is the volume of the aircraft's body. Though it is one thing to carefully design the aircraft and know the volume, after a model is created and tested the body may have slightly changed, requiring a new measurement of volume. By finding the area of cross-sections of the aircraft, the total volume can be found after the testing is finished.

2 The Problem

Given a profile of an airfoil as two curves over the domain $[0, 30]$ and data describing the two curves $f(x)$ and $g(x)$, find the area of the airfoil to help find the volume of the aircraft after testing.

3 Methodology

18 data points were provided to describe the two curves f and g . By providing a numerical approximation of the two curves and combining the two approximations, the total area of the airfoil can be found. The Composite Simpson's Rule was used because the error for this approximation is high order. This allows for more data to produce a significantly more accurate approximation using the same code. Because the data points were not evenly spaced out, 7 points were removed to smooth the spacing to $h = 3$. The remaining 11 points were used to approximate the area of the airfoil cross section.

4 Results

In Figure 1, the original 18 data points were plotted to show the cross section of the airfoil. Next to it, Figure 2 shows the 11 data points used to approximate the area of the cross section. The approximated area was 73.134 square meters for the cross section of this airfoil. If more data points were added so that more points could be used with a constant h , this method and attached code will provide a much more accurate answer because the error term has order $O(h^4)$.

5 Figures

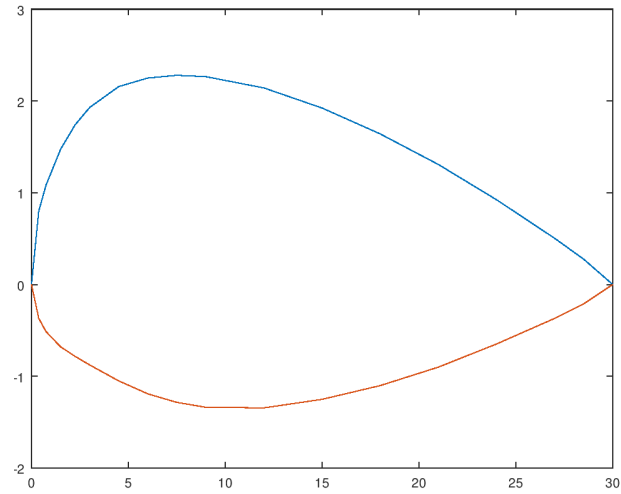


Figure 1: The cross section of the airfoil with the original 18 data points

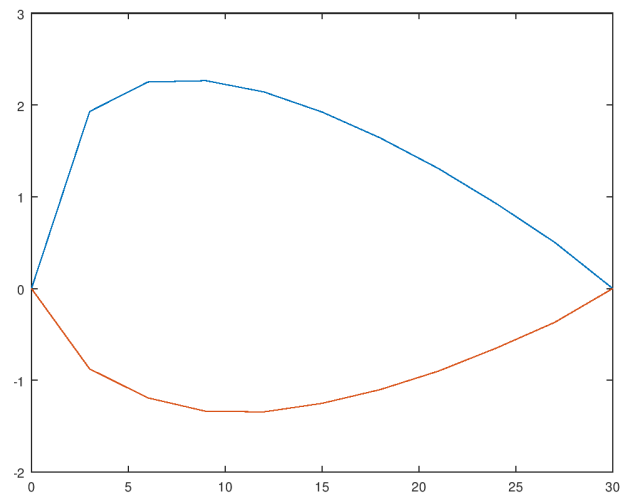


Figure 2: The cross section of the airfoil with 11 data points used to approximate the area