

Spring 2019

Sensitivity Analysis of an Airfoil using Computational Fluid Dynamics

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Savion, Itay, "Sensitivity Analysis of an Airfoil using Computational Fluid Dynamics" (2019). *Thinking Matters Symposium*. 179.

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COMPUTATIONAL FLUID DYNAMIC ANALYSIS OF AN AIRFOIL

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Abstract

In fixed wing aircrafts, the variation of lift coefficient with angle of attack is a major consideration. This project explores the variation of lift force and lift coefficient of an SD2030 airfoil as a function of the angle of attack, Reynolds number, size of the computational domain, and the CFD mesh size. The problem is modeled using the flow simulation (CDF) module of SolidWorks. The outcome has been compared with the available experimental data.

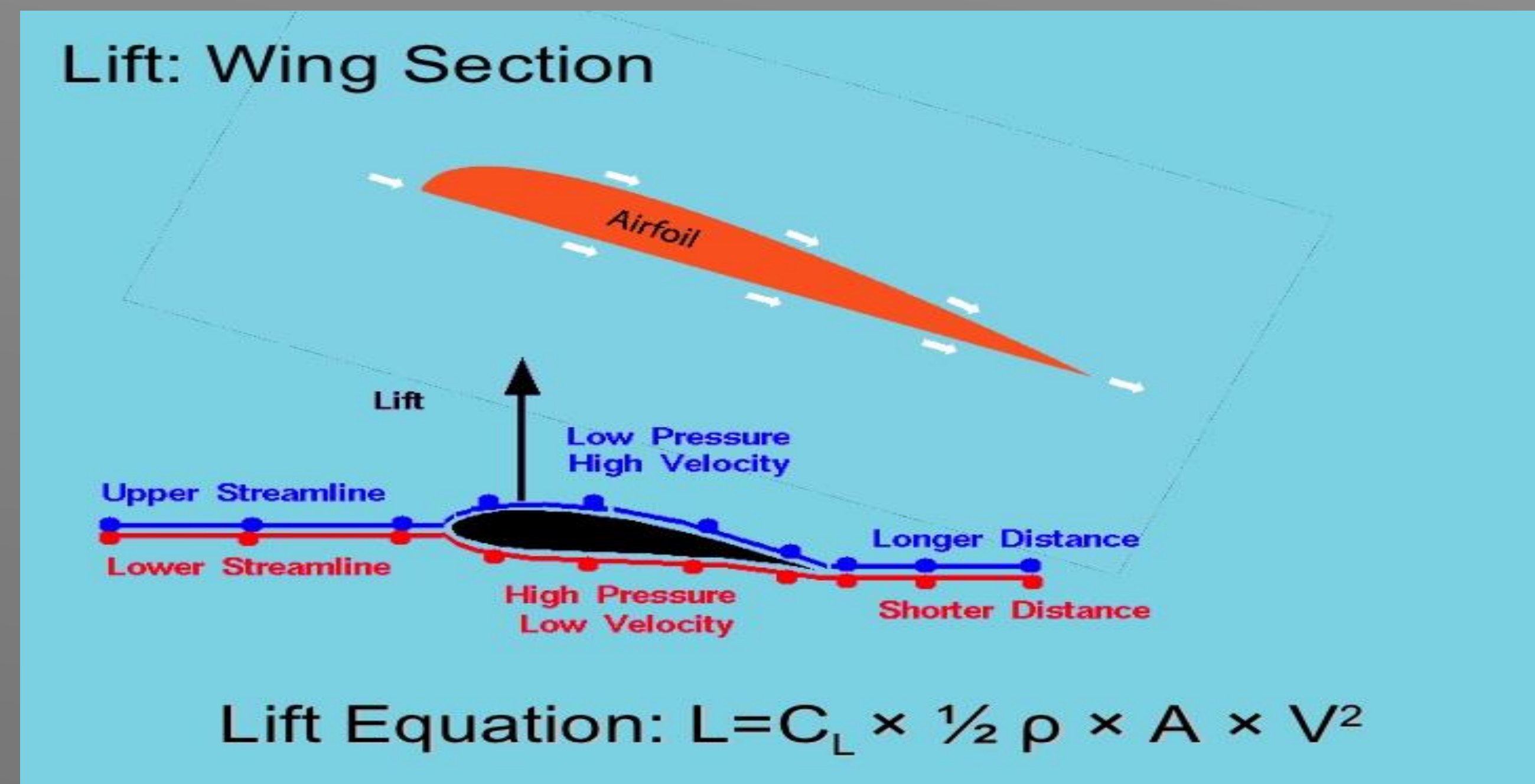


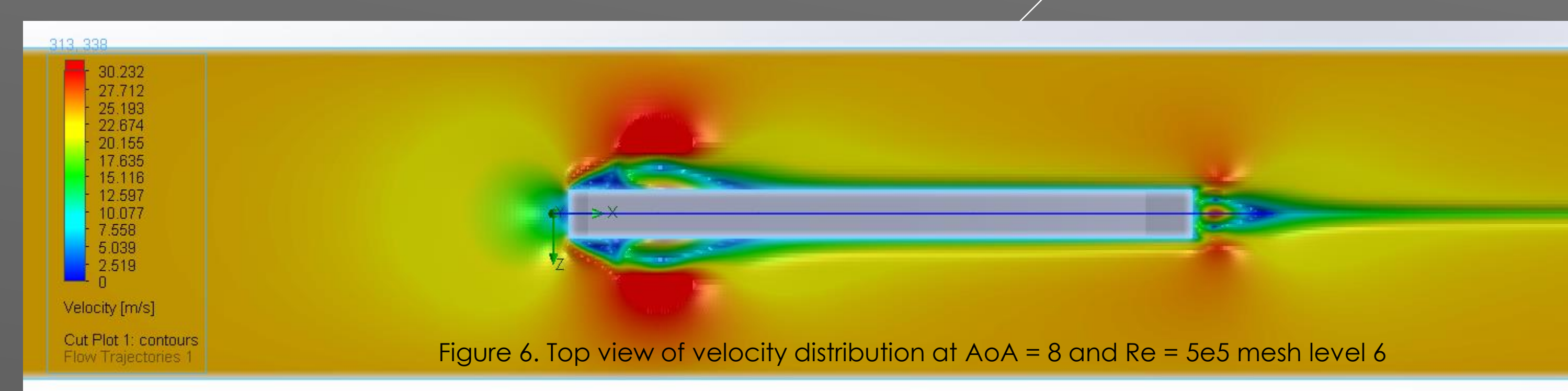
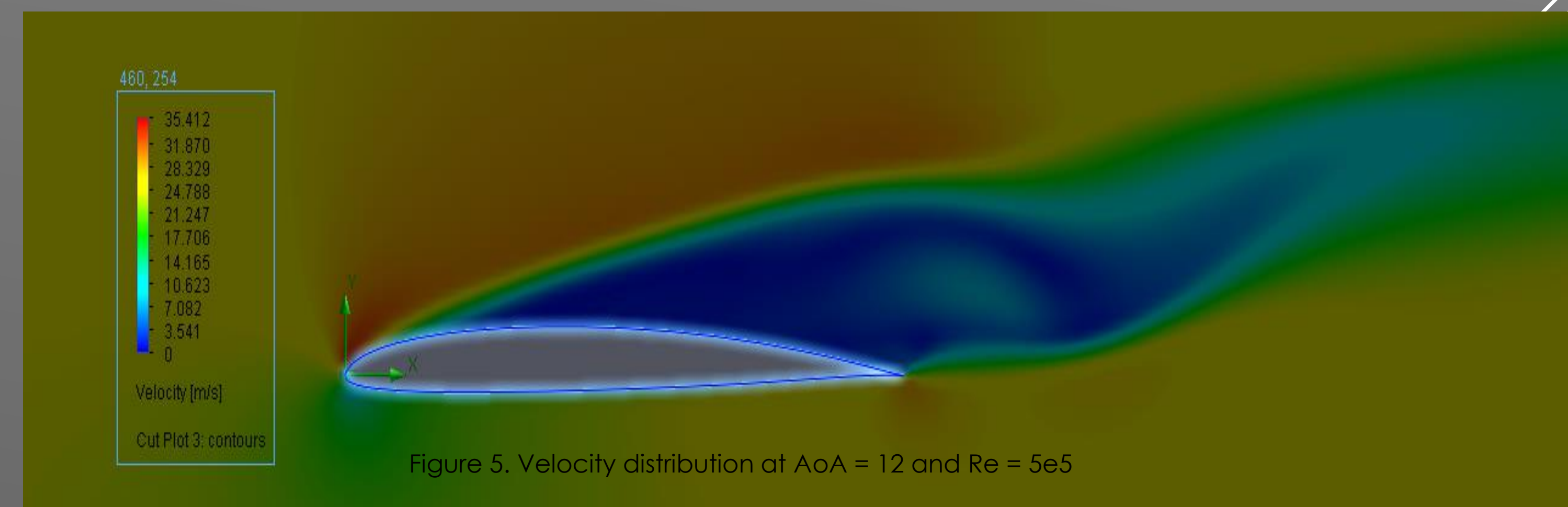
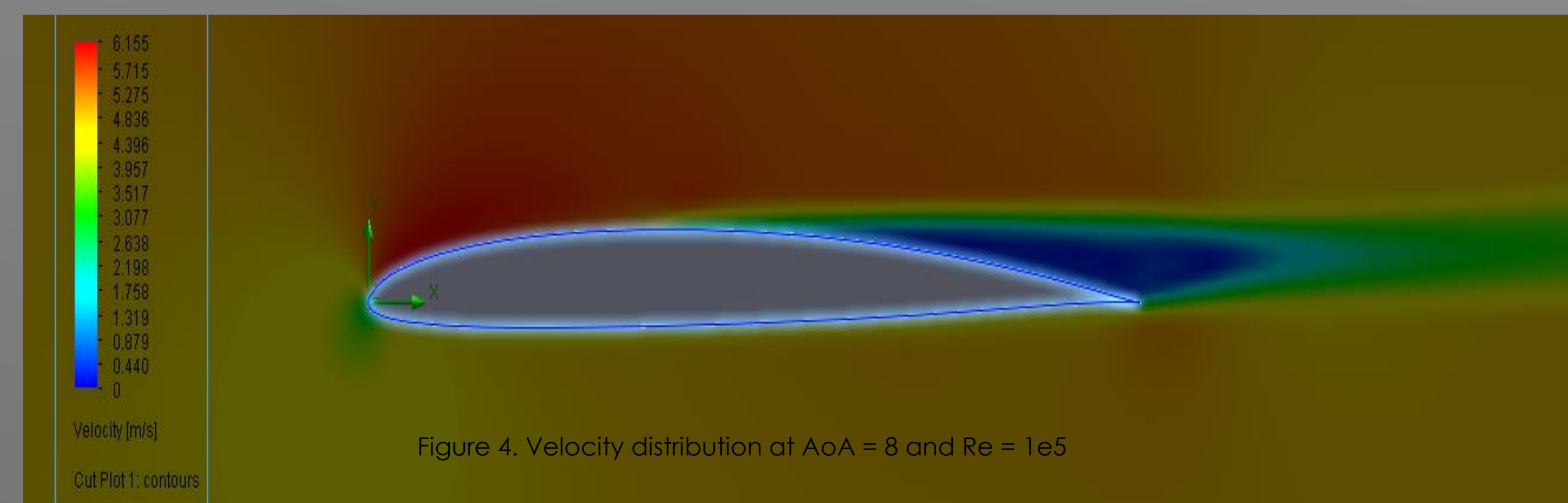
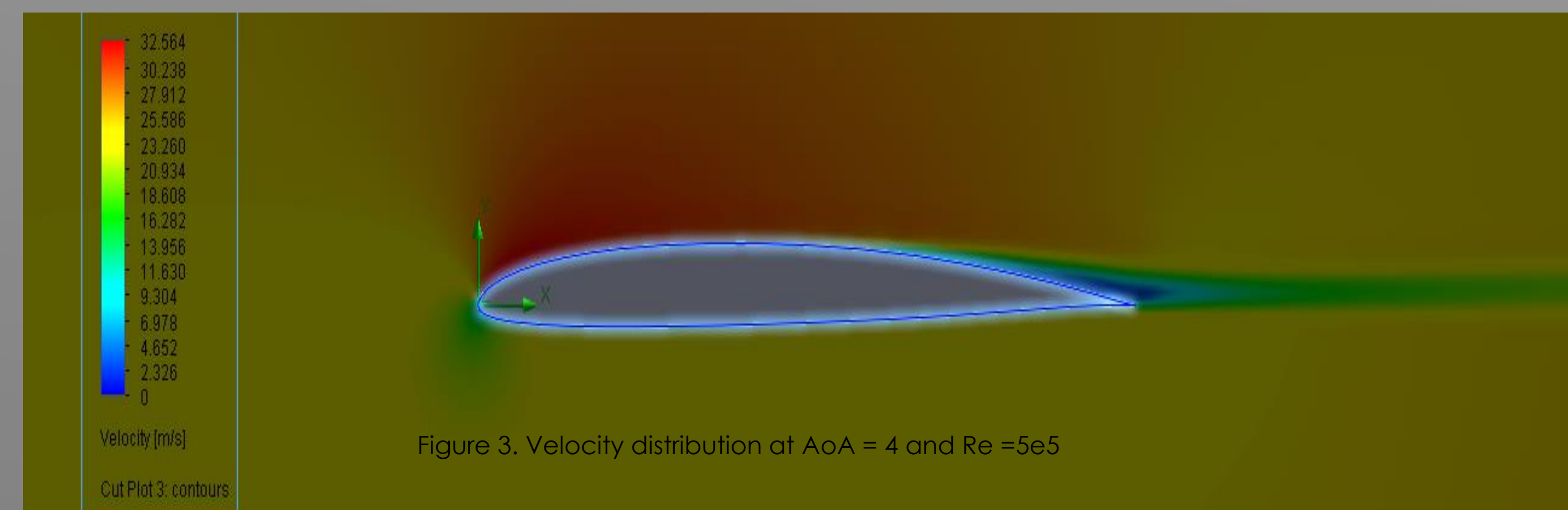
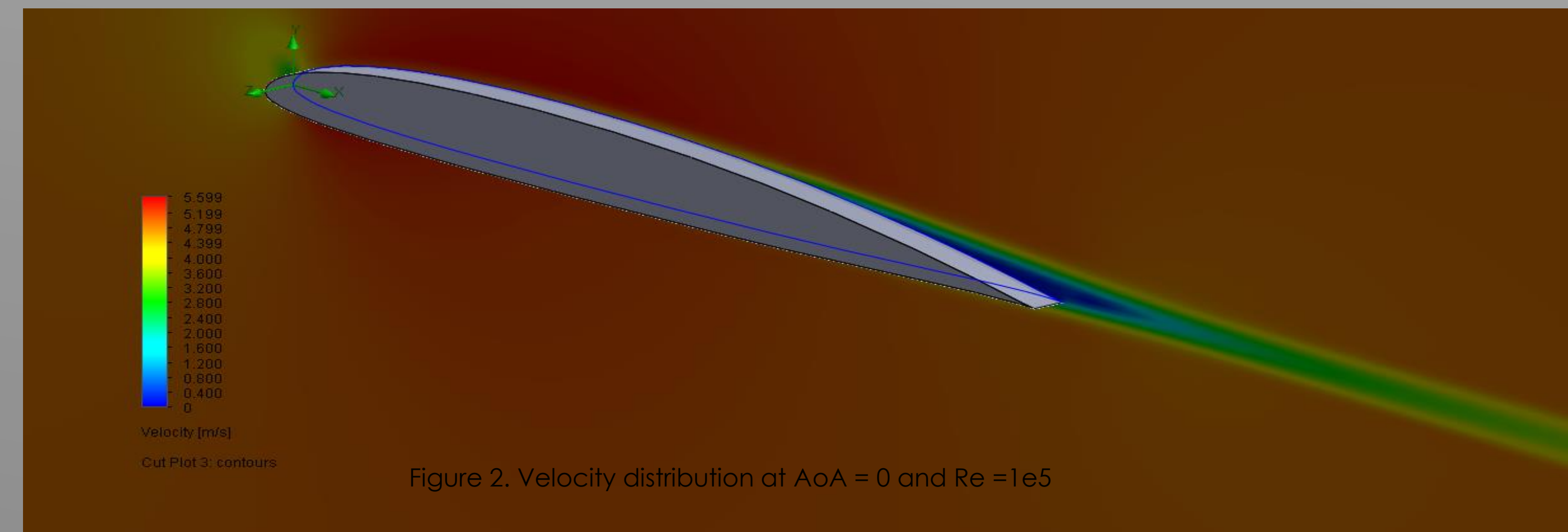
Figure 1. Lift equation

Process and objectives

- Creating a Selig/Donovan 2030 airfoil section for which experimental wind tunnel data is available for verification
- Setting a flow simulation project in SolidWorks 2018
- Running multiple iterations using different velocities while changing the computational domain and the mesh size
- Comparing the simulated data to the experimental results from Selig and McGranham (Fig. 7)

Software Operations

- SolidWorks 3D Design
- SolidWorks Flow Simulation
- MS Excel



Conclusions

- Changing the computational domain and mesh size in SolidWorks slightly affects the lift coefficient values.
- For higher Reynolds numbers, the lift coefficients are closer to the experimental values (Fig. 8)

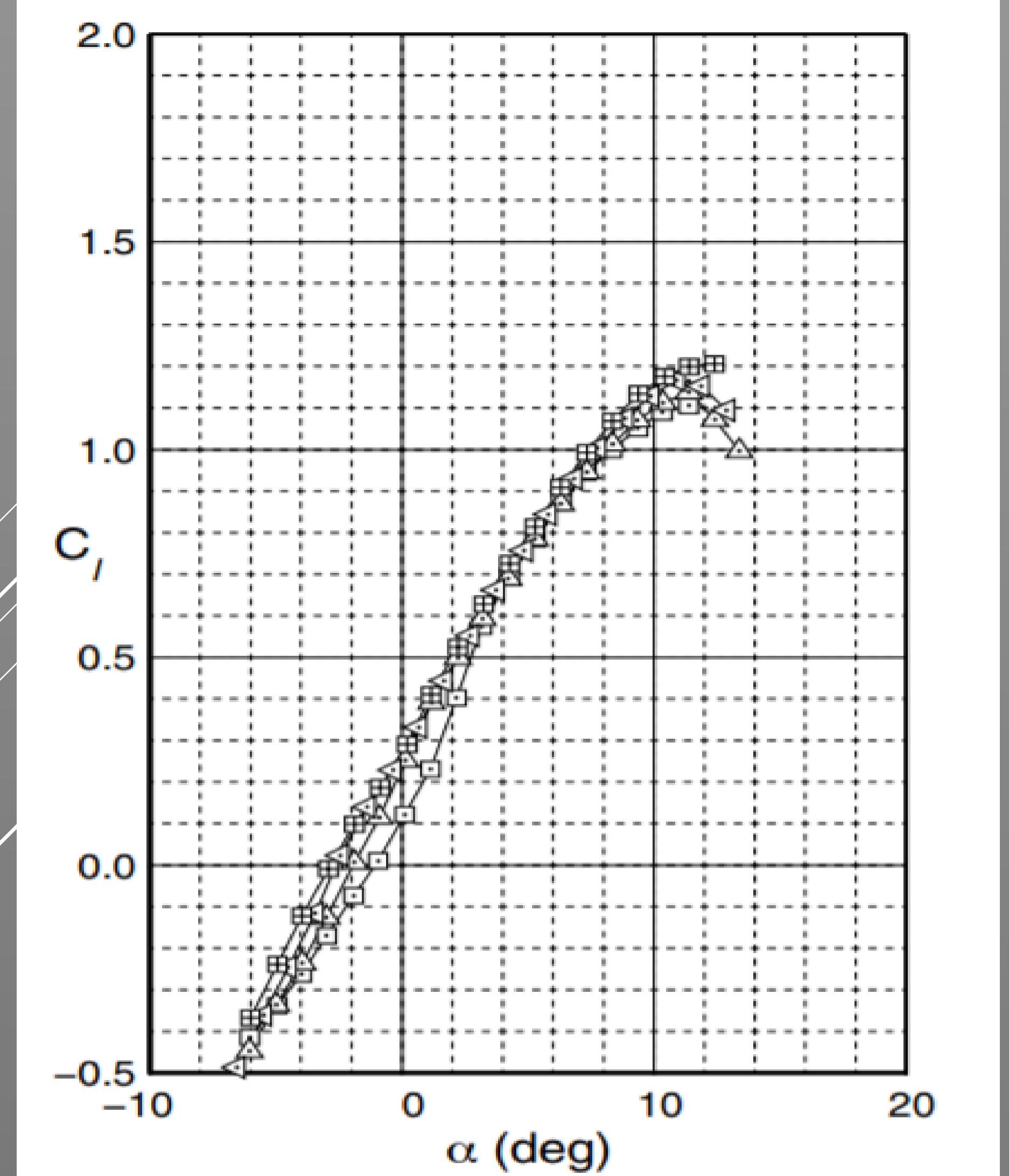
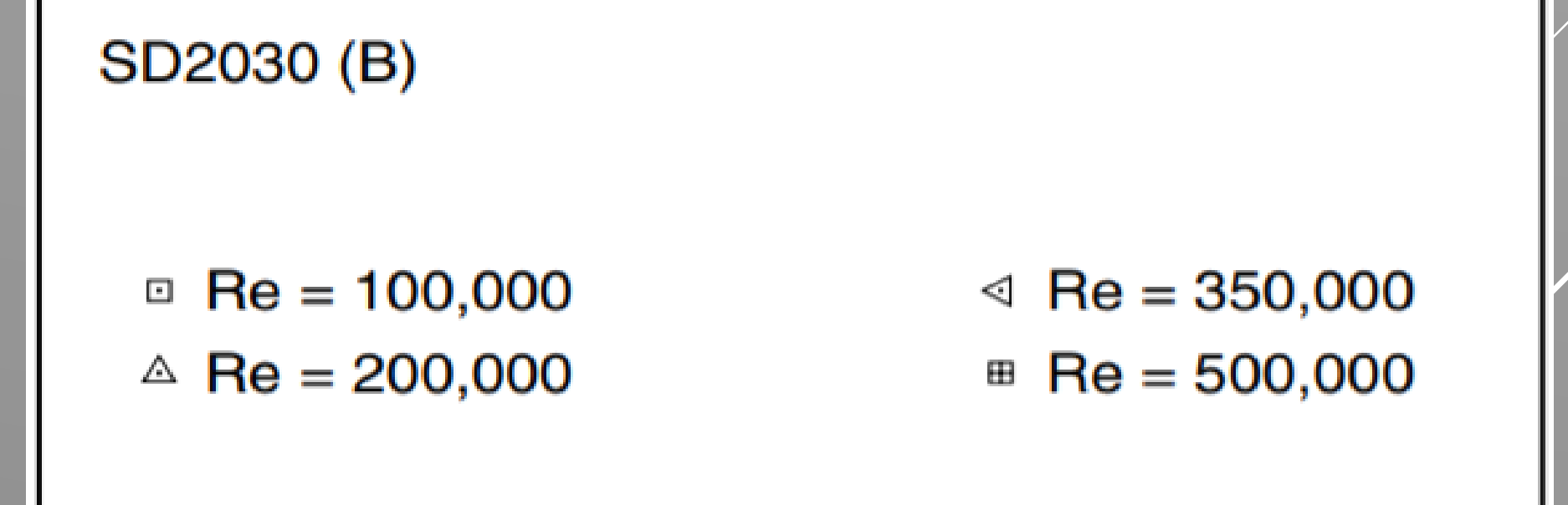


Figure 7. Graph showing AoA vs. C_L for Re in the range of 1e5 to 5e5

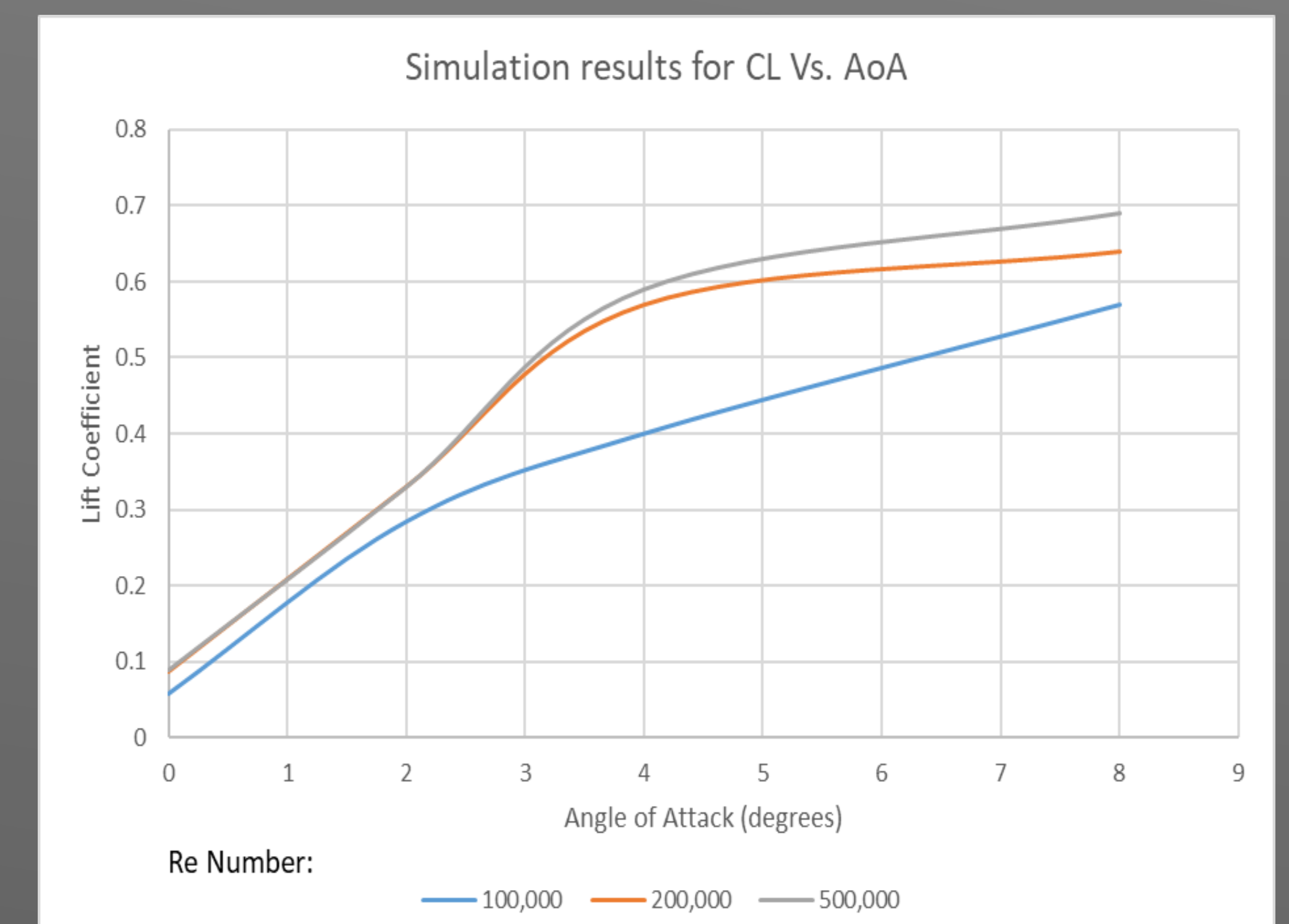


Figure 8. Simulation results for C_L vs. AoA for Re=1e5, 2e5, and 5e5