# EMPLOYING VARIOUS INVASIVE SEED DISPERSAL METHODS THROUGH ANALYZING THEIR AERODYNAMIC PROPERTIES AS A MEANS OF DESIGNING A BIO-INSPIRED WING OF ECOSYSTEM RESTORATION

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## Nomenclature

| | |
|---|---|
| $\alpha\ (AoA)$ | Angle of Attack |
| AR | Aspect Ratio |
| $\boldsymbol{a}$ | Lift slope |
| $C_D$ | Coefficient of Lift |
| $C_L$ | Coefficient of Drag |
| COG | Center of gravity |
| $\Lambda$ | Geometrical swept angle |
| b | Wingspan |
| S | Wing area |
| LE | Leading edge |
| TE | Trailing edge |

# INTRODUCTION

Restoration efforts for such ecosystems include the need to mimic the region's biodiversity before its destruction. Such tasks can be challenging in remote areas.

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Efforts to repopulate degraded ecosystems take on methods such as the deployment of drones to disperse seeds.

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Key characteristics:

Swept wing

wings are angled behind the center of the seed to give it more stability and are slightly tapered toward the tip to make it lighter with less drag

sharp leading edge and an aspect ratio (AR ~ 3-4)

*the lowest rate of descent with a high wing loading*

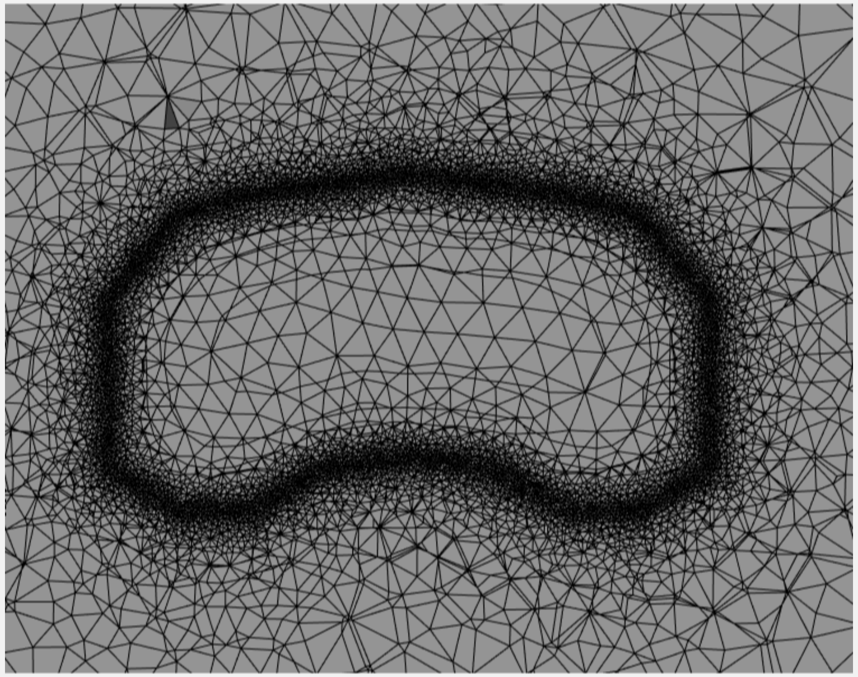
# PROBLEM STATEMENT

- Due to the advent of monoculture, deforestation and habitat destruction caused by human activities, the biodiversity of many environments has severely been impacted. The challenge of this project is designing an aerodynamic wing for seeds to be dispersed in more remote areas to improve efficiency in its deployment.

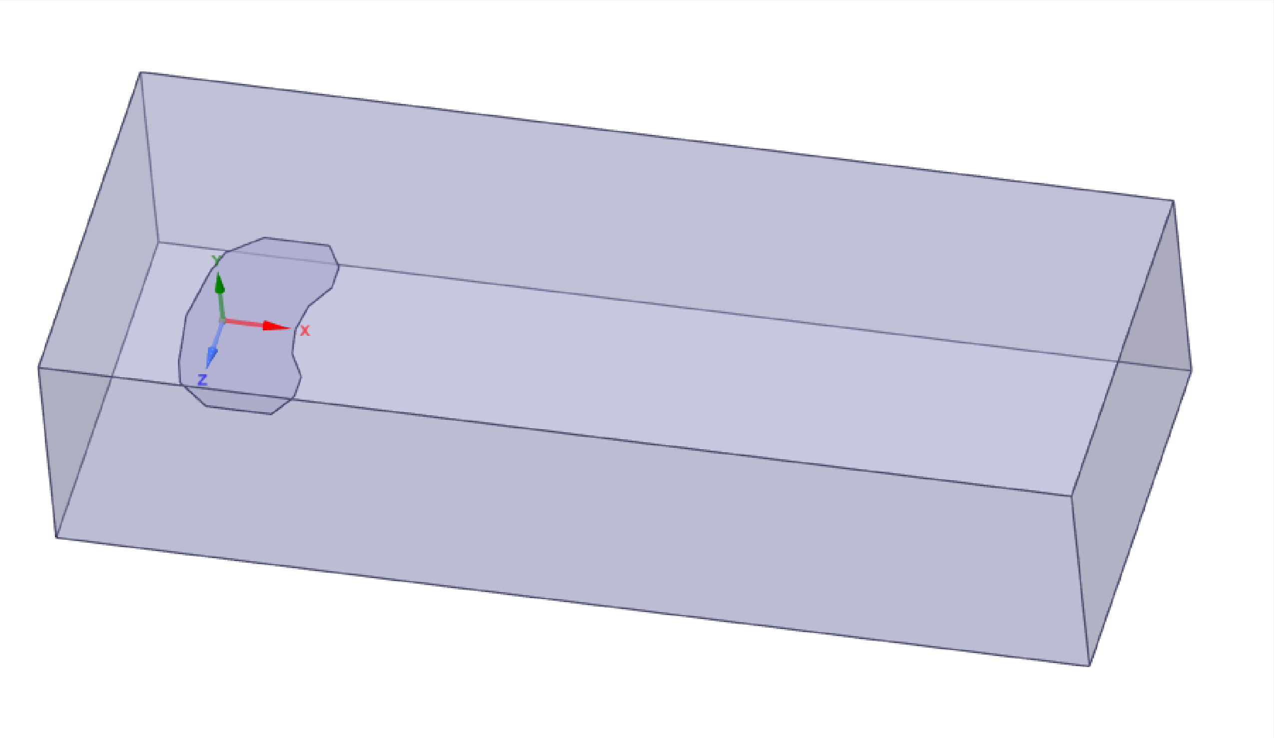
# METHODOLOGY

CFD set up

- K-omega SST model
- enclosure dimension values are based on the aspect ratio of the airfoil (143 mm).
- The mesh setup uses an unstructured tetrahedral mesh, with a growth rate of 1.3, and a element inflation layers with proximity.
- Re value of 50,000 and 20,000



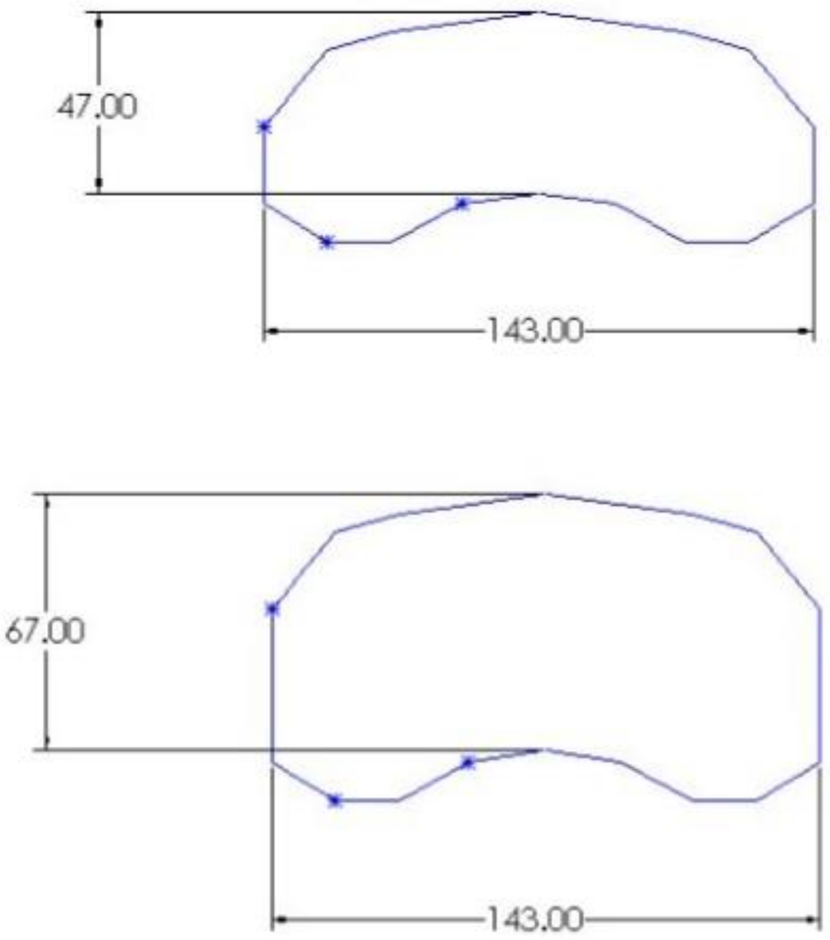
# LIMITATIONS




Limited accuracy from a CFD analysis.
Simplified geometry for easier analysis (comparing the factors that leads to change in aerodynamic parameters)

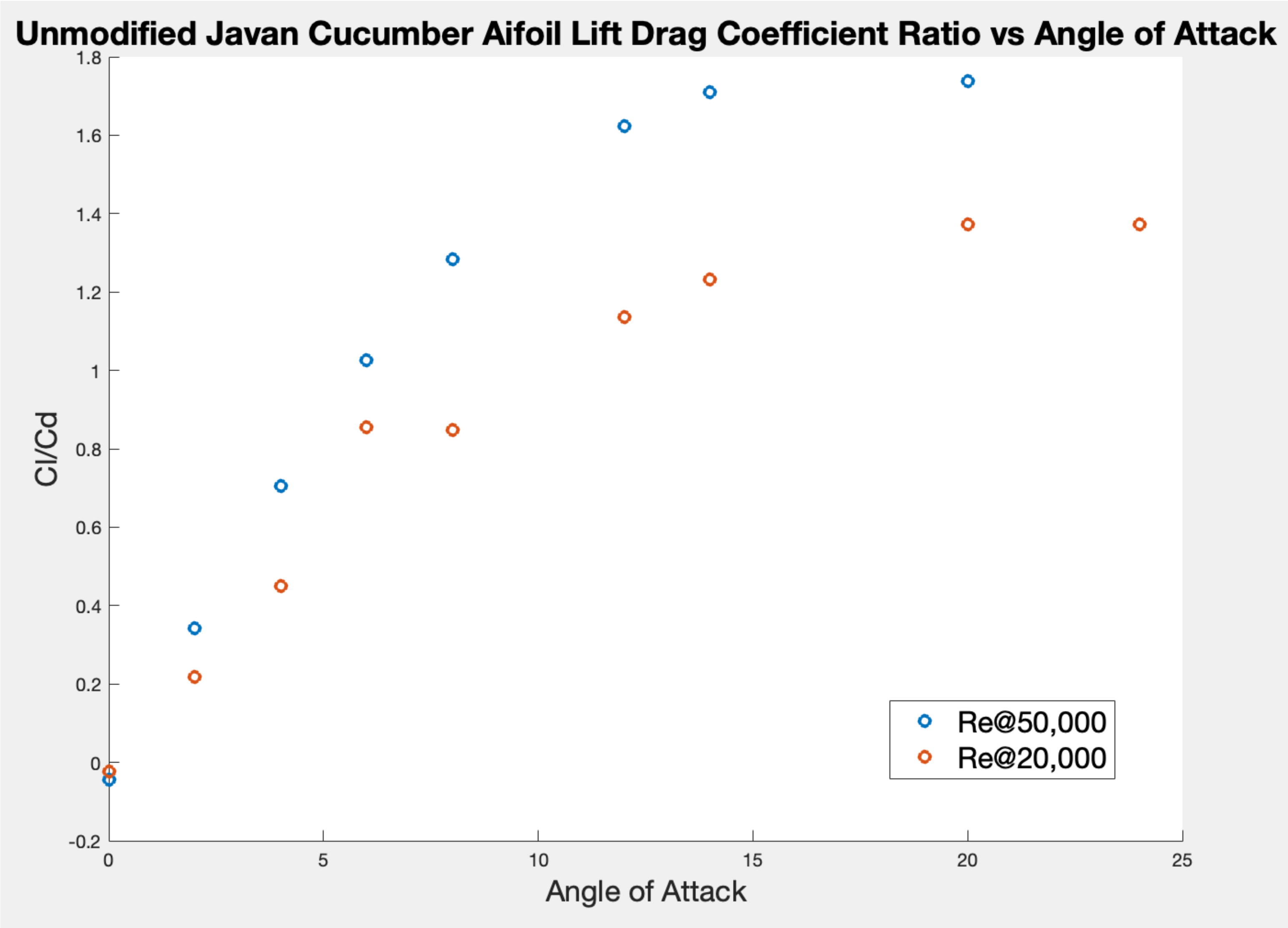
# DESIGN PARAMETERS

key factors to improve upon from the unmodified form is an increase lift slope as well as a higher maximum coefficient of lift. Performance of the airfoil should be consistently better for different Re numbers in order to consider an airfoil that is more adaptable to more environments.

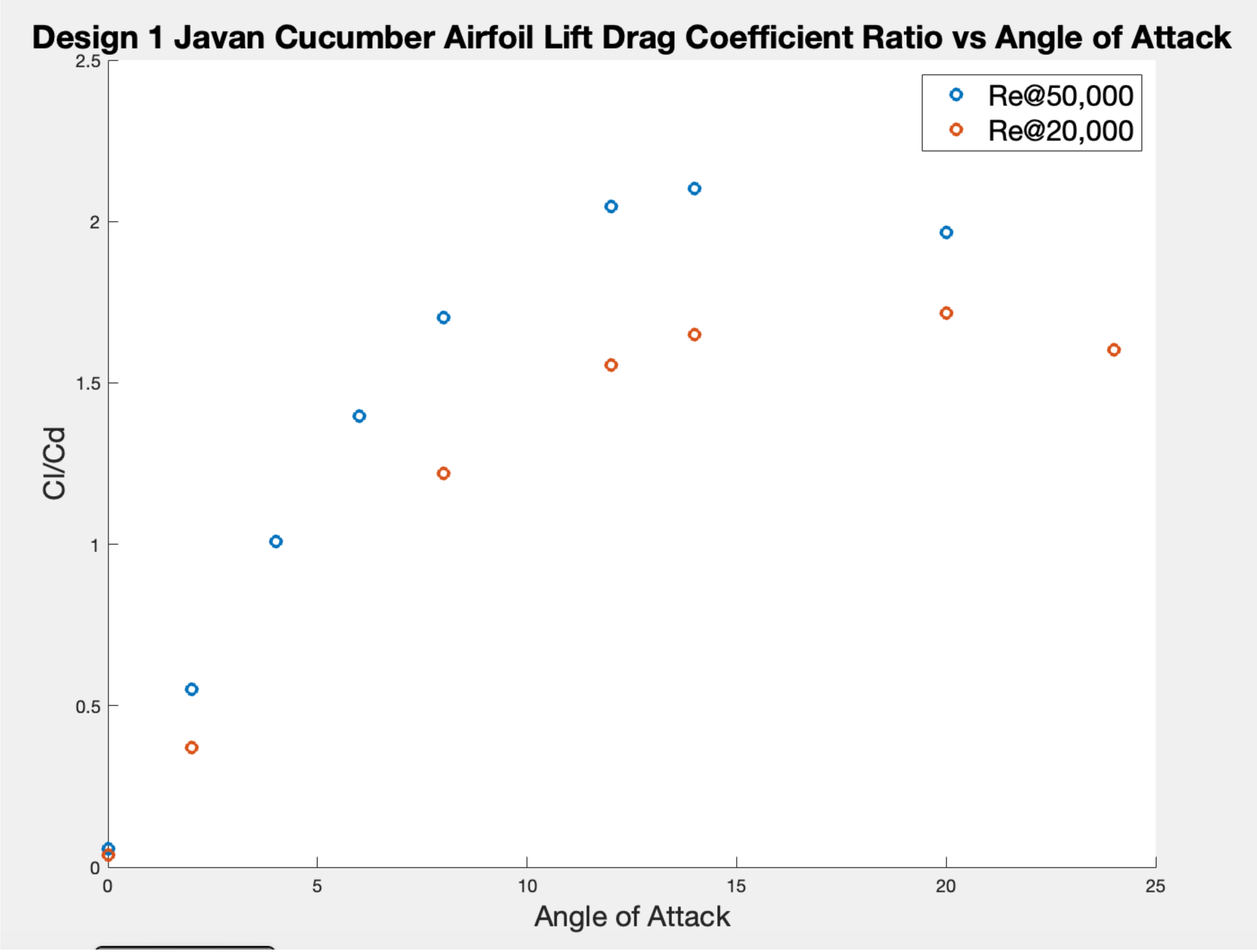



Comparation of the nonmodified airfoil and Design 1.

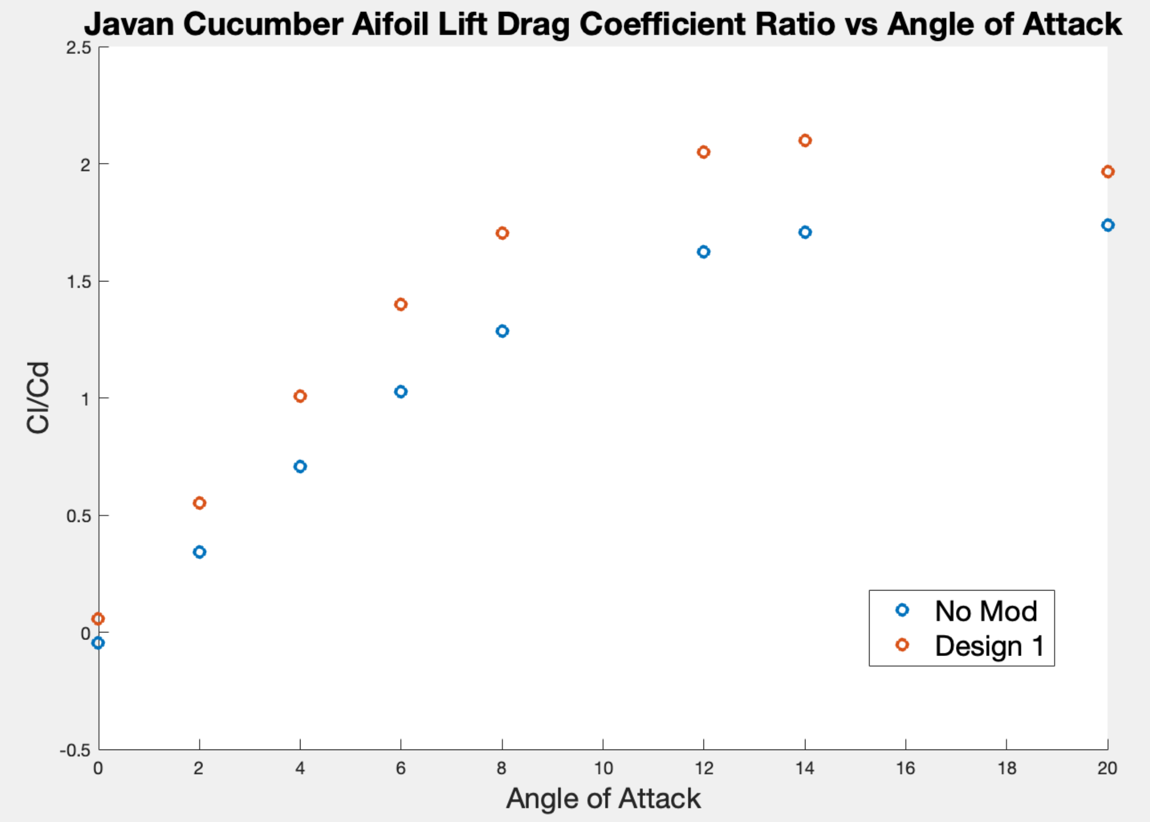
# RESULTS/DISCUSSION



RESULTS/DISCUSSION



# RESULTS/DISCUSSION




Re @ 50,000, V= 5 m/s

Higher lift is more relevant than reducing the induced drag. Design modification one allowed for a lower AR than with the nonmodified wing.

# TO-DO / CHALLENGES

- Changing different parameters in design to see change in efficiency
- Analysis of results in terms of the positive contributions (in better performance for problem statement)
- Parameters needed for analysis of design parameters

# REFERENCES

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