Evolutionary Algorithms for Airfoil Design

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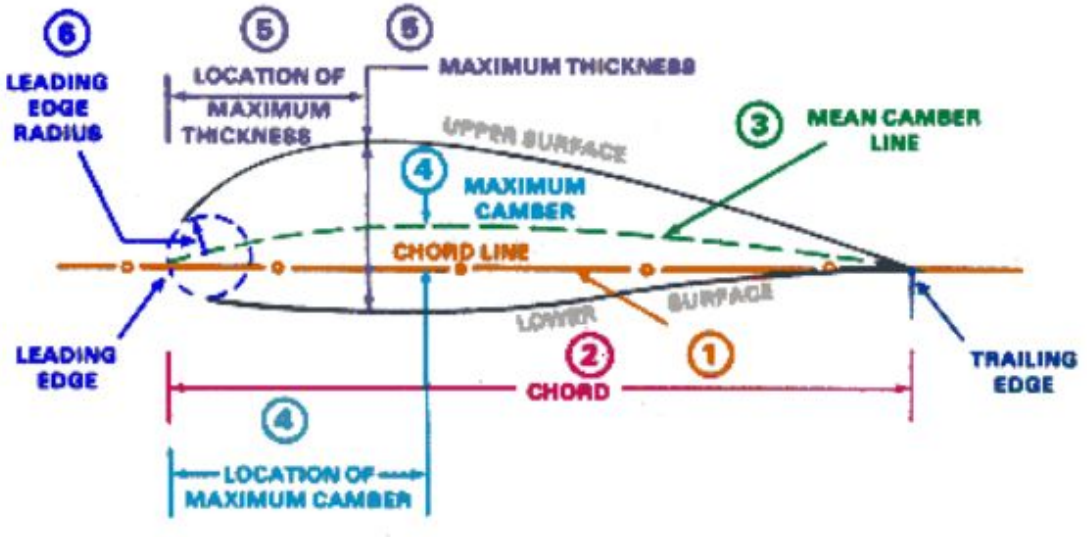
Agenda

Time	**Planned Activity**
2 Minutes	Background on Airfoils
10 Minutes	Evolve Your Own Airfoil and Discussion
3 Minutes	Our Version of the Algorithm
5 Minutes	Questions

So, what is an Airfoil?

An airfoil describes the shape of cross-section of an object which when moved through air creates an aerodynamic force.



Credits: http://aviationknowledge.wikidot.com/aviation:aerofoil

Factors affecting the lift acting on an airfoil:

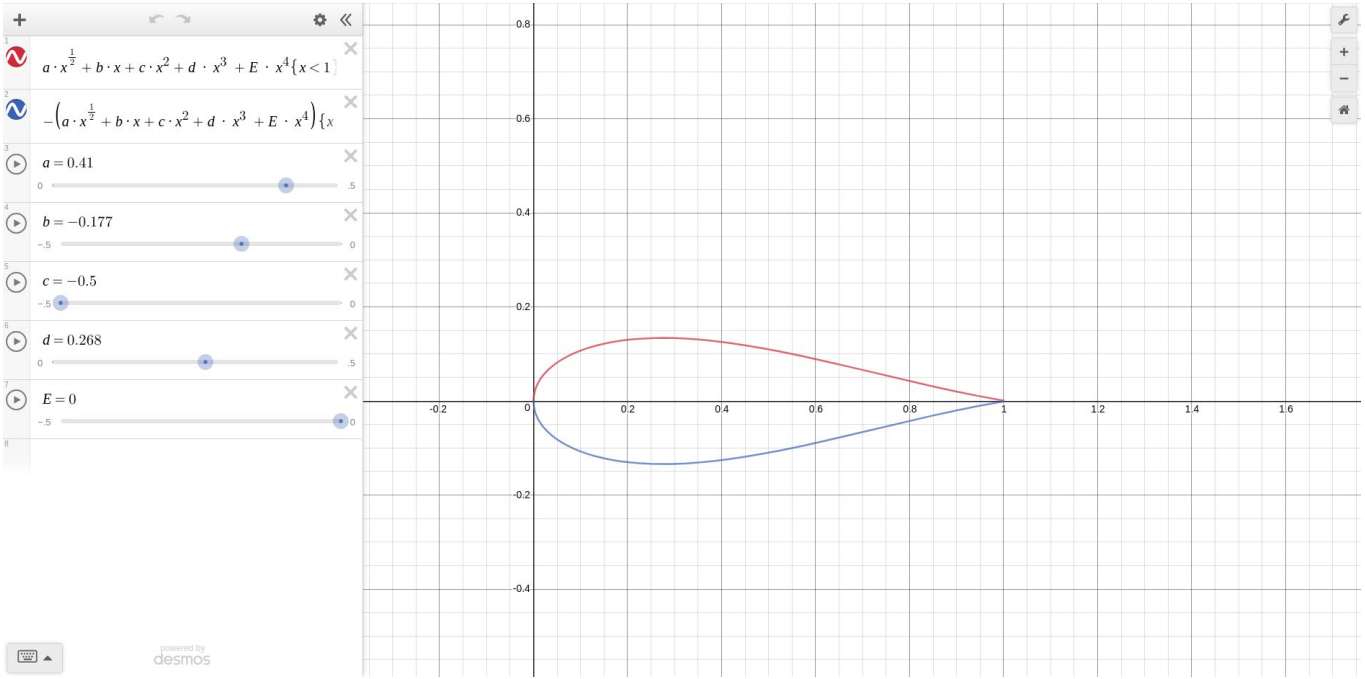
- Shape and size of the wing
- Angle of attack
- The speed of motion of the wing
- Density of air / drag produced on the wing

What we evolve:

Shape and size of the airfoil based on its effect on the rest of the factors - coefficient of lift and coefficient of drag - sweeping across *various angles of attack*.

Evolve Your Own Airfoil

https://tinyurl.com/y4c99l7j



Make Your Own Airfoil Activities

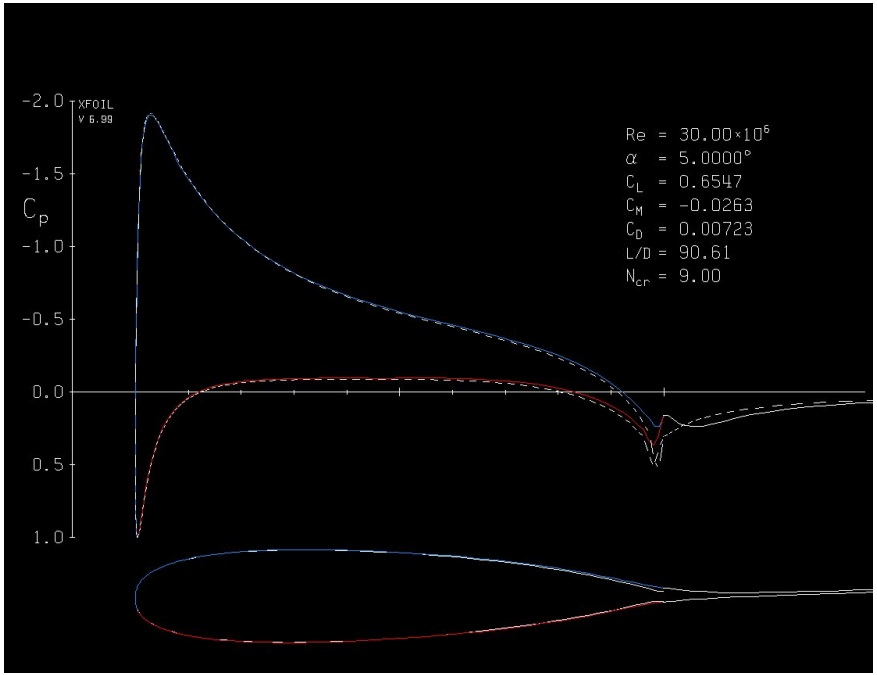
2 Minutes	Play around with the variable with the intent of designing a “good airfoil” (based on your intuition)
2 Minutes	Discuss with your the class on your considerations for designing a “good airfoil”
1 Minutes	Compare your airfoil with a neighbor and exchange one of the coefficients to design a better airfoil (your ‘a’ with their ‘a’) - only keep the best one from the pair.
2 Minutes	Share the created airfoils with the class
1 Minutes	Find another pair of people and “mutate” one of the coefficients
2 Minutes	Report findings to class

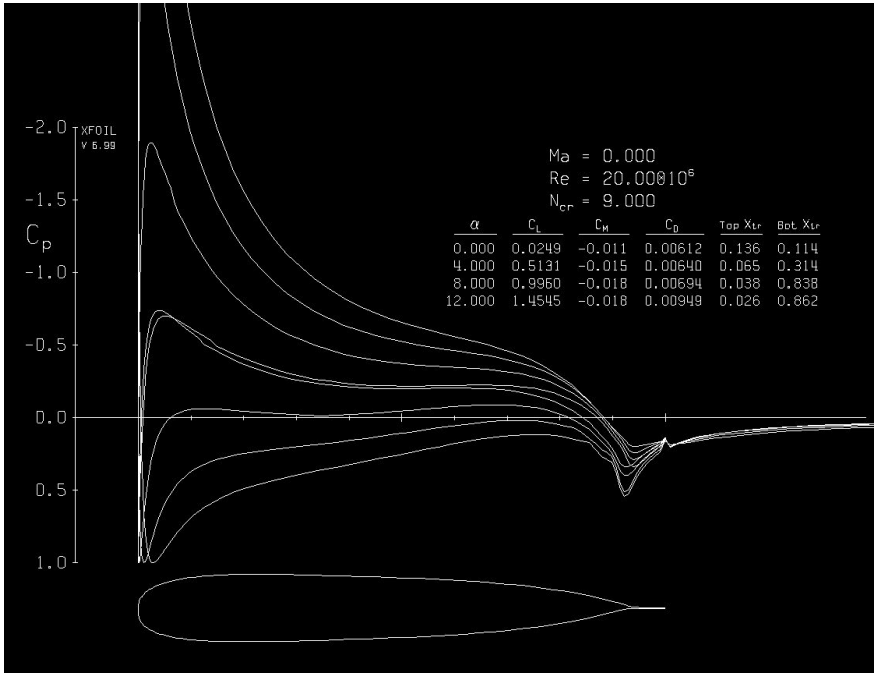
Directions for Mutation

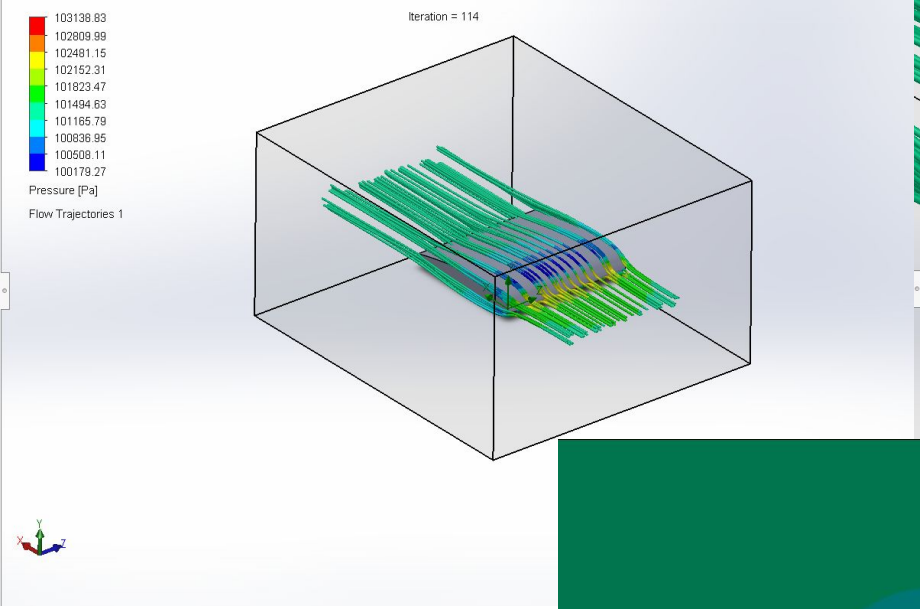
- Think of a random decimal between 0 and 0.5
- Choose a coefficient to mutate
- Add or subtract this from one of the coefficients, if this is out of range move it as far as you can

- Is this airfoil better? Why or why not?

What We have Evolved



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Pressure [Pa]
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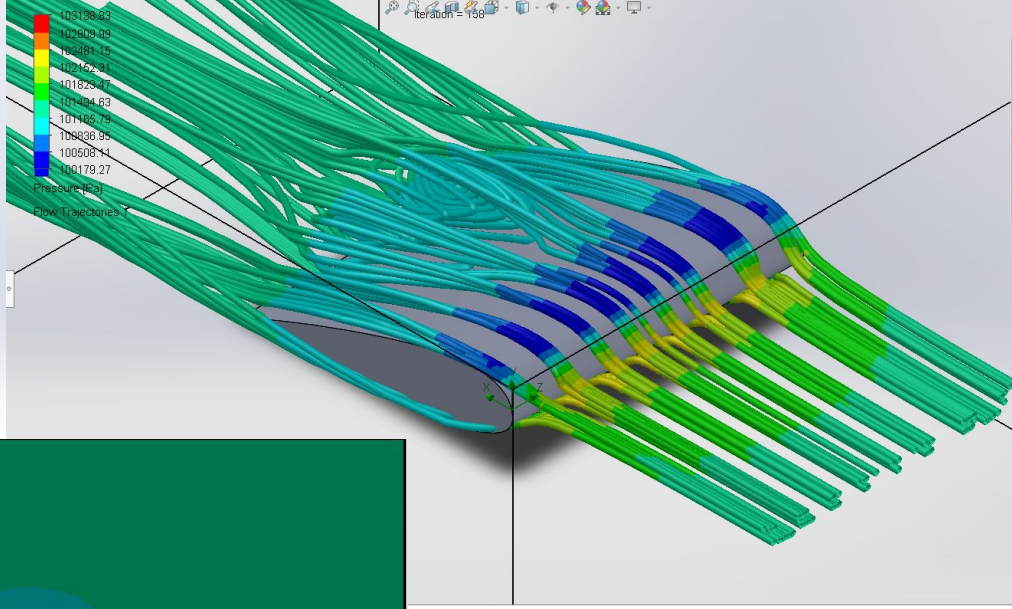
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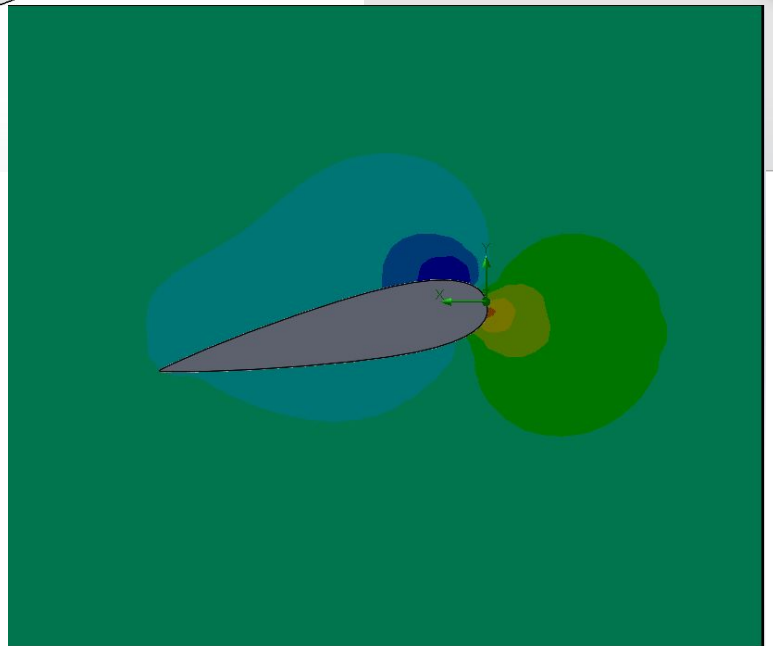

Our Fitness Function

We are currently evaluating our foil based on the ratio of the sum of its coefficients of lift and drag over four different angles of attack. This gives us a good indication of how the foil performs in a wide range of scenarios and helps to get a good balance between high lift and low drag.

How does this compare to what you did?

Do you have any suggestions for improvement?

Discuss the Process of Evolution

- Which process (mutation or crossover) yielded a better foil?
- How did your airfoils compare to the ones our algorithm created?

Questions? Comments? Concerns?

Please use this time to fill in our survey.