AeroSim

v0.1

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Doc Version: 0.1

Development

# 1 Introduction

The core goal of the initial versions is to simulate wind/air flow. This should be doable with a Eulerian fluid simulation, much like the simulator that Matthias Muller wrote. There are two things that will be used to test this. First, I would like to show how air flows through ductwork. Second, I would like to simulate how wind interacts with a cloth sail. Ultimately this is the starting point for a sailing simulator. Assuming that the processing power is there. This could also fizzle out into nothing as well.

## Purpose

The early versions are a proof of concept. Air flowing through ductwork shows that air is flowing correctly with constraints of collisions. Then create a real-time simulation of wind over the sail(s) and control the sail shape with visual feedback in the form of luffing.

## Intended Audience

The initial target audience is Prof Toth. Post-semester, it will become friends, family, and anyone else who will listen to me yammer on.

## Scope

For the time being the scope of this project is air flowing through ductwork and then over a single fixed shape sail. Future revisions will Incorporate multiple cloth sails that interact with the wind.

## Definitions, Acronyms, and Abbreviations

None

## References

Matthais Muller – Ten Minute Physics: [www.matthiasMueller.info/tenMinutePhysics](http://www.matthiasMueller.info/tenMinutePhysics)  
https://matthias-research.github.io/pages/tenMinutePhysics/17-fluidSim.pdf

## 1.6 Revision History

0.1: This version

# 2 Tools

## 2.1 Libraries

Unity 2022.3

## 2.2 APIs

None

## 2.3 Services

GitHub: https://github.com/mltngpot/AeroSim  
Jira: https://pitheguy.atlassian.net/jira/software/projects/AER/boards/2

# 3 Physics Engine

## 3.1 Data Models

Box – a unit cube, each side has a vector for the flow.  
Zone – a collection of Boxes that will indicate the volume of three space that is being simulated

## 3.2 Interfaces

## 3.3 Helpers

## 3.4 Services

## 3.5 Error Handling

# 4 Frontend

## 4.1 User Interface(s)

### 4.1.1 Views

#### 4.1.1.1: Main Scene

This scene will initially show the zone, with the corners of the boxes shown as dots. There will not be any objects shown until the user requests to do so. There will be an on-screen navigation as described in section 4.1.2.1.

### 4.1.2 Menus

#### 4.1.2.1 Main Scene Menus

More of available buttons/fields  
Slider to control wind speed, some thing to control direction, buttons to show/hide object, list of potential objects (eventually sails) to use.   
Builder Mode option to allow duct work.

## 4.2 Actions/Flows

None

# 5 Database

No Database

# 6 Processes

## 6.1 Operational

### 6.1.1 Task development

Branches will be named from the Jira Task (ie AER-1). Tests must be written and passed before merging into main. Team of one, there are no Code Reviews, there is no develop branch.

## 6.2 Automated Actions

None

## 6.3 Events

None

# 7 Infrastructure

None

# 8 Testing

Testing initially should cover making sure the formulas are working correctly.

# 9 Future Planning

Cloth sales that are capable of luffing in light wind/improper trimming.  
Main Sail on a mast creating a Sloop.  
Additional Sails: Genoa, Spinnaker  
Additional Rigs: Cutter, Ketch/Yawl

# Appendices

# A Task List

AER-1: Build Cube  
AER-2: Build Zone  
AER-3: Directional Arrows   
AER-14: Move math to compute modules  
AER-4: Wind Velocity  
AER-5: Wind Direction  
AER-6: Airflow Lines  
AER-7: Add Smoke  
AER-8: Obstacles   
AER-16: Build sample duct  
AER-17: Build duct fixtures (wye, tee)  
AER-18: Build duct input source (generator)  
AER-19: Build duct output (black hole)   
AER-20: Duct Builder  
AER-9: Airfoil/Plane wing  
AER-10: Fixed Shape Sail (Jib)

--- Stretch Goals   
AER-11: Cloth Sail  
AER-12: Main Sail  
AER-13: Genoa  
AER-15: Lines to trim sails

## B Reference Figures

A sailboat parts diagram

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