# Synthetic Data Pipeline for Pose Estimation (Milestone 6)

Group: Nathan Pichette, William Stern, Stephane Baruch, Hanibal Alazar
Faculty Advisor: Dr. Ryan White

# Overview of Milestone 6

- Added all customization to the toml files
- Made the camera view changeable
- Created a Demo Video
- Got evaluation from client team
- Created the user/developer manual
- Refactor code

# Milestone 6 Matrix

| Task | William | Nate | Stephane | Hanibal |
|---|---|---|---|---|
| 1. Finish adding all customization to the toml file. | 85% | 15% | 0% | 0% |
| 2. Make camera view changeable | 100% | 0% | 0% | 0% |
| 3. Work on video demo | 25% | 25% | 50% | 0% |
| 4. Get evaluation from client team | 33% | 33% | 33% | 0% |
| 5. Work on user manual and developer manual | 25% | 25% | 25% | 25% |
| 6. Refactor code | 90% | 10% | 0% | 0% |

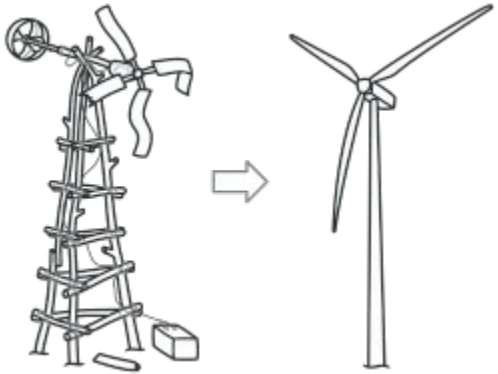
# 2nd object function

- We added a feature for our 2nd object function. This is the function where you can add a scale feature that is able to change the size of the 2nd object .
- This 2nd object can be anything object such as the Earth, moon, or another satellite.
- We also implemented a boolean function that enable/disables the 2nd object

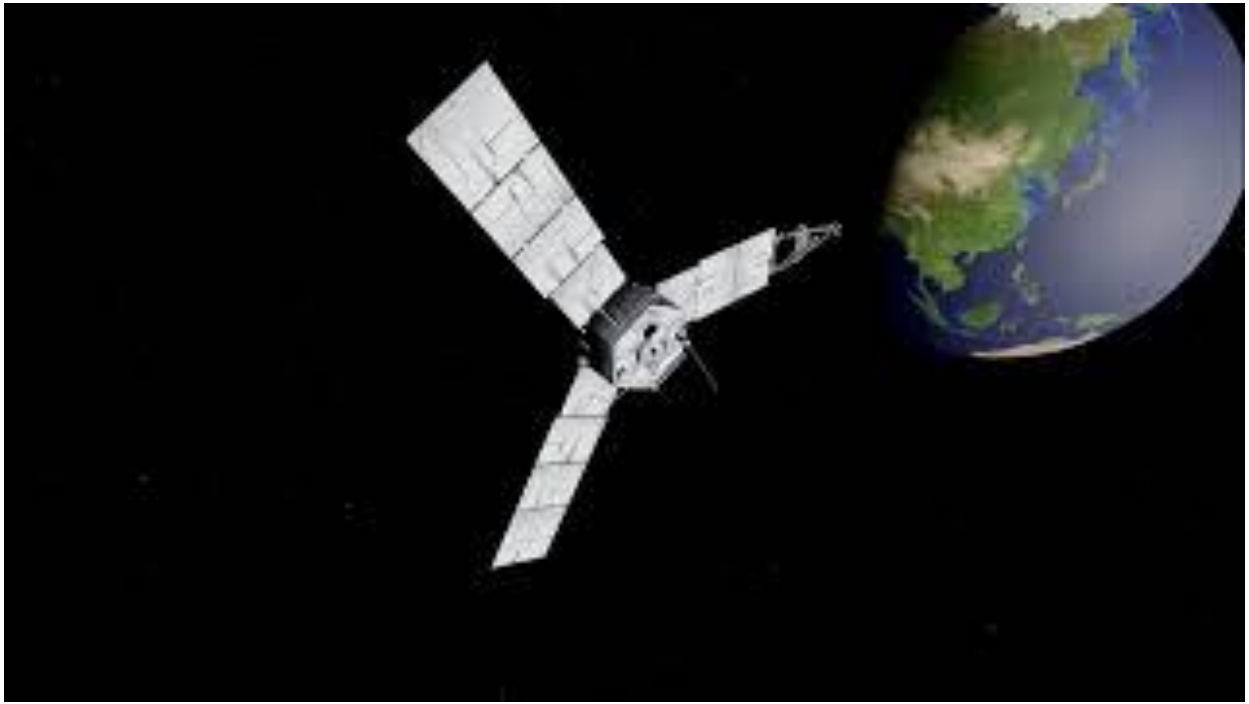
```
[earth]
earth_file = "/models/earth/Globe.obj"
earth_location = [25, 0, 0]
scale = 0.01
earth = false
```

# Refactoring the file

- We took out unnecessary code, created more functions, and commenting code
- We added documentation for our code and tested all of the components



# Demo Video



NORTHROP GRUMMAN
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# Synthetic Data Pipeline for Satellite Pose Estimation

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## Motivation

The currently there is no simple way to create synthetic satellite motion data. Currently users need to animate a single clip for every use case needed. We seek to create an easy to use pipeline for generating large amounts of synthetic data for use in satellite pose estimation.

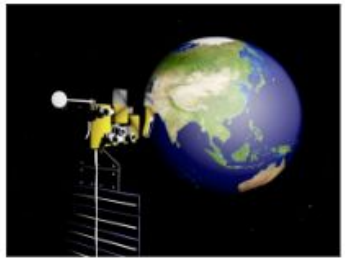
## Goal

- Create an automated system that can render footage of a satellite in motion
- Enable the user to upload their models and backgrounds
- Allow for adjustable the path of motion and lighting features
- Allow users to easily adjust settings

## Features

- Custom .obj model and .jpg background selection
- Satellite and Camera motion based onreceived functions or interpolated from point values
- Lighting from a point or grid sun lighting from specified direction
- The program can generate a 3D star background or use a static JPEG image.

## Rendered Image



## Configuration

```
[lighting]
light_type = "SUN"
location = [10, -10, 10]
energy = 10000
rotation = [0.0, 0.14, 0.0] #Necessary if using sun

[camera]
location = [0.0, -6.5, 0.0]
rotation = [1.5, 0.0, 0.0]
lens = 20

[satellite]
satellite_file= "/models/nasa-aqua-satellite-obj/nasa-aqua-satellite.obj"

[background]
background_filen "/code/space.jpg"

[flightpath]
flight_path_type = "FUNCTION" #
positions = [[0,0,0],[5,5,1]] #If using "POINT"
rotations = [[0,0,0],[0,0,0]]
x_eq = "t-24"
y_eq = "2"
z_eq = "tat"

[animation]
# yes or no for still or video
animation_length = 2 # in seconds
file_format = "JPEG"
output_dir = "Frames/img"
```

## Tools Used

- Blender - 3D environment
- BPY - Python library to control 3D space and objects in Blender
- TOML - Configuration file
- Github - Project housing and version control
- TQDM - Progress bars

## Limitations and Improvement

- It can be difficult to estimate the flight path and speed of objects without running the program. Potential improvements include creating a visualization tool to help the user create good flight paths.
- Currently the program requires admin access on some operating systems

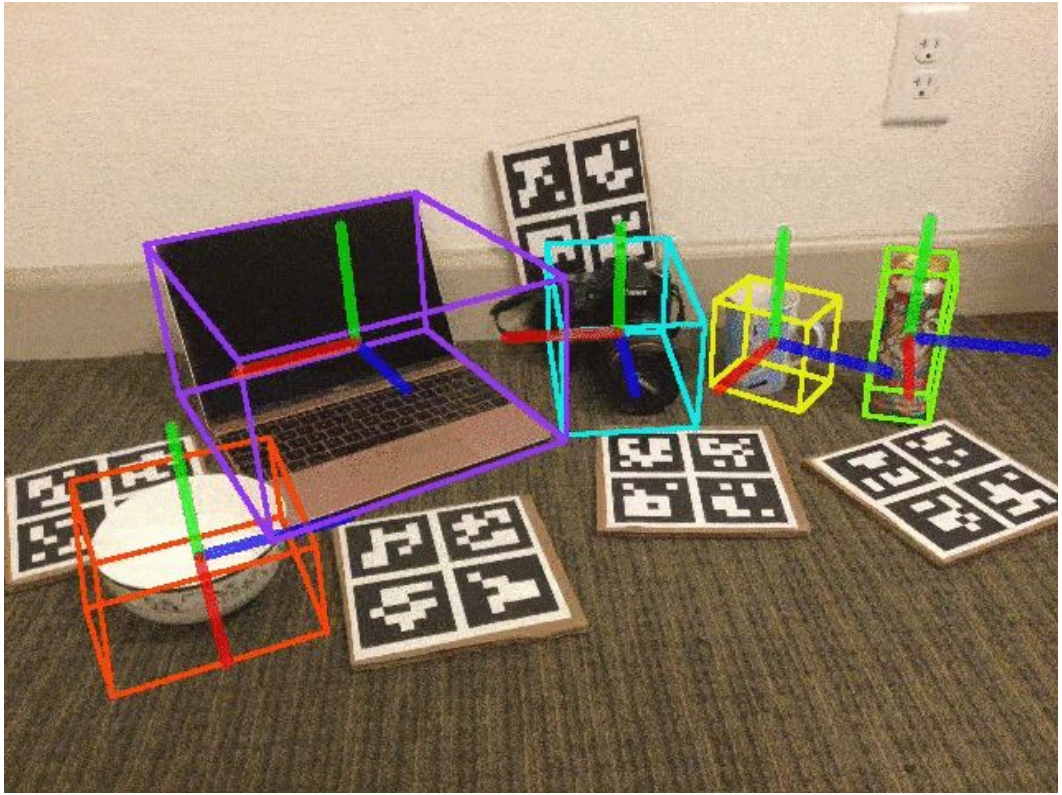
## Evaluation/ future work

The data pipeline was evaluded for ease of use and received positive feedback. Researchers will utilize the project to generate data for the purpose of training machine learning models, which will enable the prediction of satellite movement and rotation.

# Lessons Learned

- Start early
- Use good communication
- Collaborate often
- Do it right the first time

# What will this be used for?



# Questions?

Thank you!