Oscillatory UAV Landing Platform

Team 3

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ABSTRACT

With the popularity of Unmanned Autonomous Vehicles (UAVs) increasing in the past few years, the need for effective training equipment for UAV pilots has become more pressing. Although these vehicles are not manned, they still pose a safety risk to those around it as they become projectiles if control is lost. Our project aims to provide challenging training environment where pilots can practice take-off and landing procedures in a safe and controlled manner. While the platform is able to simulate a variety of scenarios such as a turbulence or uneven landing surface, it was specifically developed to simulate the motion of a moving vessel in the open sea. The platform is able to replicate the roll, pitch and heave of a vessel and can be adjusted to simulate different degrees of motion based on different measures of the Beaufort scale. The Beaufort scale is a system that correlates wind speed with the effects it has on sea conditions based on observations from the wave patterns.

The Capabilities of our design are:
- Operates between a Beaufort scale of 1 and 8
- Complete platform is estimated to weigh approximately 50 lbs
- Can accommodate UAV's of up to 33 lbs
- Able to displace approximately 20" in pitch and roll while having a vertical displacement of about 1.5 ft

DESIGN PROBLEM

The aim of the project is to develop a platform that can simulate the motion of the sea for a wide range of Beaufort scales

Our Team

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WHAT IS OUR PROJECT ABOUT?

The vision for this project is to develop a platform that can self-level to expand the conditions in which unmanned aerial vehicles can take off and land. However, for this project, the scope was limited to manufacturing a platform that can mimic the motion of the sea at different Beaufort scales.

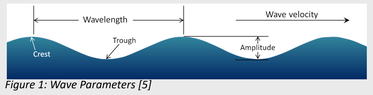


Figure 1: Wave Parameters [5]

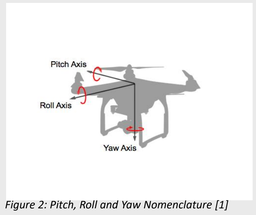


Figure 2: Pitch, Roll and Yaw Nomenclature [1]

DESIGN PROCESS

Conceptual Designs

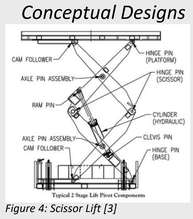


Figure 4: Scissor Lift [3]

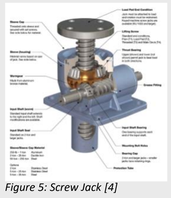
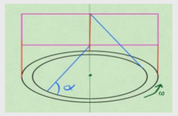
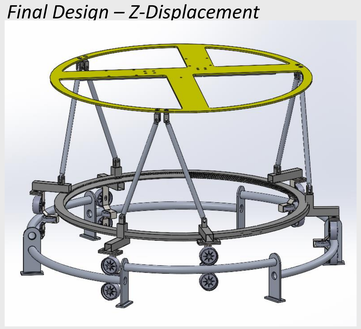


Figure 5: Screw Jack [4]



Final Design – Z-Displacement



Z-Displacement - Highlights of Design
- Track + Wheel Design
- Rods system elevating and lowering the platform
- Lightweight and transportable
- Requires less force than scissor/spider lifts

WHAT IS THE BEAUFORT SCALE

The Beaufort scale is an internationally recognized scaling system utilized to measure wind strength. This scale depicts the force of wind through a series of numbers from 1-12, increasing in overall wind strength. Wind strength is correlated to various sea conditions, such as wave angle, speed and height.

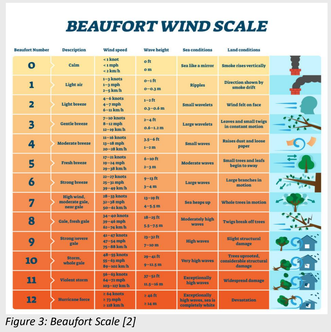
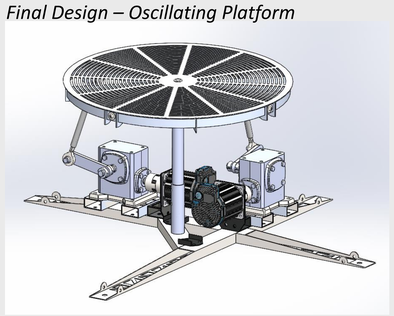


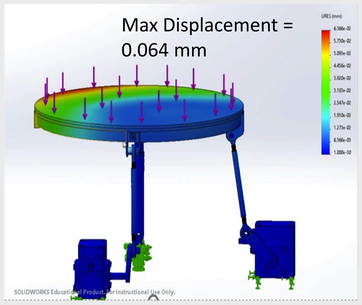
Figure 3: Beaufort Scale [2]

Final Design – Oscillating Platform



Oscillating Platform - Highlights of Design
- Added ribs underneath both platforms for extra support and to prevent sag.
- Increased Landing Pad thickness to 1/8 in
- Changed material of mounting T to steel (vs aluminum) to support heavier loading scenarios

Static Analysis – Platform Strain



FINAL DESIGN

Final Design – Combined Platform

PRACTICALITY

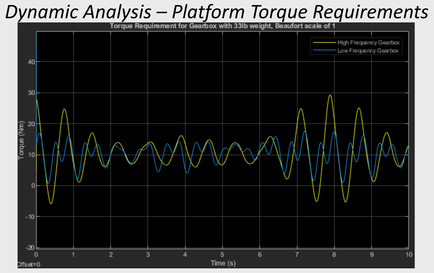
The purpose of this project is to create a landing platform that will stay level when a sea vessel is navigating rough seas. UAV operations at sea are challenging, due to the roll and pitch movements of the ship and the interaction of the hull with waves and swell. Our drone platform enhances the safety of such operations and can significantly increase the weather window for the performance of maritime and offshore UAV activities.

SAFETY

There are two main safety features integrated:
1. Safety lights to display when platform is active
2. Sound horn to further signal the activation of platform

The UI also includes safety buttons to disable the platform and warning screens for potential operating dangers

Dynamic Analysis – Platform Torque Requirements



INNOVATION

This platform brings new technologies to the table by implementing a system that allows the controller to know each motor's angular position in order to identify pitch/roll requirements for each given Beaufort step. The innovation of landing platforms has greatly improved the efficiency and safety of transportation by allowing vehicles to land in areas that are otherwise unsuitable for traditional runways.
Additionally, the implementation of a z-displacement platform adds a new element to the design.

FEASIBILITY

- Light weight, which increases versatility during transportation.
- Accessible material utilized which are readily available locally.
- No complex manufacturing methods were used.
- Requires only basic and commonly sized tools for assembly/disassembly.

MANUFACTURING METHODS

- Waterjet
  - Utilized in cutting 3/8" flat bar and 1/8" sheets Aluminum into the top landing pad and supporting components as the Ribs and C-Channel.
  - As well as motor component connections and internal column supports.
- Mill and Lathe
  - Used in the creation of the center support rod and assembly components, using Aluminum and Carbon Steel stock.
- Welding
  - TIG and MIG welding were utilized in connecting the Ribs, C-Channel and center rod assembly to the top platform.
- Plasma Cutting
  - Utilized to cut the triangular pattern on the Carbon Steel pipe in the base of the design

MATERIAL SELECTION

To increase the ease of transportation, different materials were considered, however, most of the components used are made of Aluminum. Aluminum was chosen due to its high strength to weight ratio and its ability to resist corrosion making it ideal for marine applications.

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