Attachment Mechanism for use in a Two-Wheel Autonomous Electric Aircraft Tug

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Motivation

Fuel Cost, pollution, and noise can be lowered at airports with the use of an autonomous electric aircraft tug. This requires a wheel attachment mechanism that can be operated with **no human assistance**.

Objective

Scale single wheel prototype to accommodate larger dual wheel nose landing gear

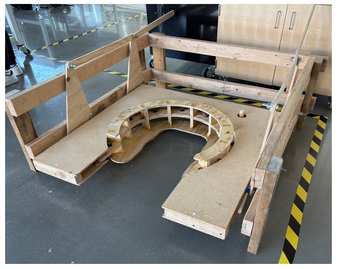


Class of 24'-25' Single Wheel prototype

Prototyping



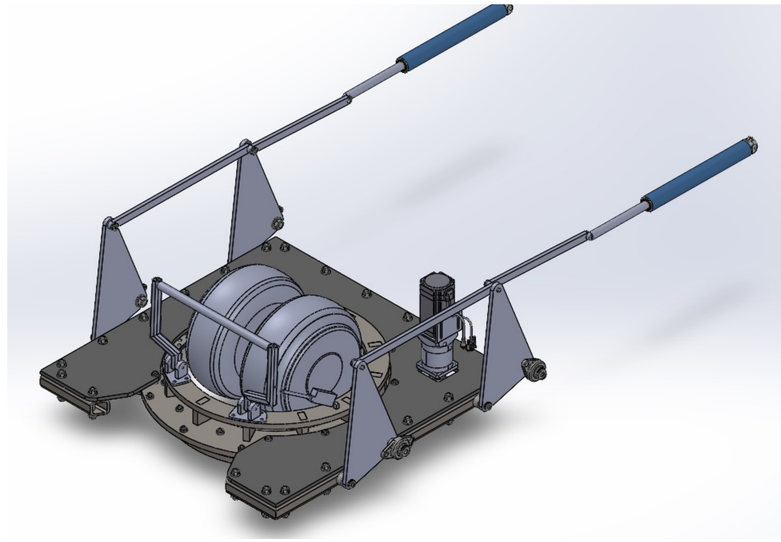
1/10 scale 3D printed used to iterate on turntable platform design

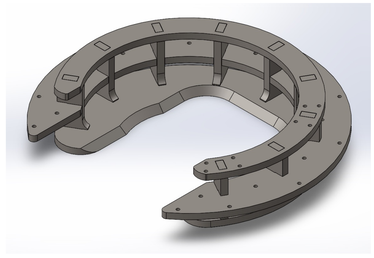


Full scale wooden prototype of final design to test sizing of parts, and lifting and rotation mechanisms

Final Design

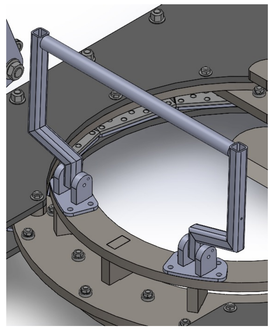
The final design consists of a **turntable platform** which will support the aircraft wheels during lift. A **four-bar linkage lift** is utilized to keep the platform level during lift. An **attachment arm** will lower over the top of the wheels to always maintain **three points of contact**. Two electric rams will be used to lift the platform, and a stepper motor will rotate the turntable

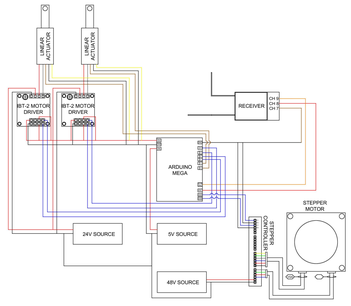




The turntable consists of **three plates**. The top plate provides an area for the attachment arm to mount. The **middle plate** provides **structural support** and is connected to a motor with a chain to provide rotation of the turntable. An **array of bearings** support the middle plate from below The bottom plate supports the aircraft wheels

Attachment arm is mounted with custom mounts to prevent interference with aircraft wheels



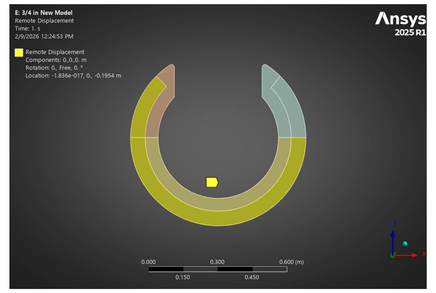


Wiring diagram of mechanism which includes two **electric linear actuators**, two **stepper motors**, and a remote receiver. The system uses three voltages for power and multiple motor controllers for proper performance. The entire system is controlled with an **Arduino Mega**

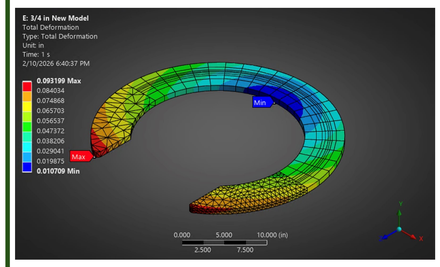
Analysis

Finite element analysis (FEA) was performed in Ansys to evaluate stress distribution and deflection in the center turntable plate under extreme conditions.

The turntable model was modified to allow for proper boundary conditions to be simulated; the turntable is supported by an array of bearing plates underneath half of the turntable's surface area.

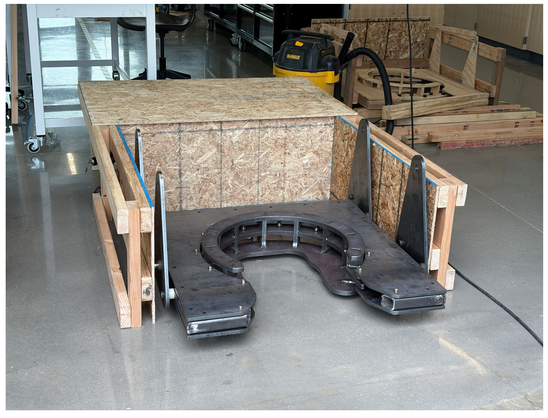


Under extreme conditions a portion of the center plate is unsupported while under a **maximum load of 7000 lbs.** The number of simulated nodes in this area was increased to allow for more accurate stress and deformation results



A total deformation of **<0.1in** was achieved with a ¾'' steel plate. This amount of deformation ensures the turntable can fully rotate without **no interference** with the frame while under load

Final Build



The final build is made of steel and is mounted to a wooden testing platform to simulate the size and shape of the **Lektro Aircraft Tug**

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