Wyoming Cloud Radar 4 (WCR4) Lower Antenna Mounting Structure

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Client: Nicholas Mahon, University of Wyoming Department of Atmospheric Science

Project Description

The University of Wyoming Atmospheric Science Department requires the installation of the Wyoming Cloud Radar Four (WCR4) on their new King Air 350i research aircraft for the purpose of supporting scientific missions for the National Science Foundation. The motive of this project is to design, evaluate, and fabricate a mounting structure that will integrate the WCR4 and its two lower antennas to the primary aircraft structure. This project will include designing and modeling a structure using SolidWorks, validating the structure's compliance with the relevant Federal Aviation Administration (FAA) regulations through a formal structural stress report, production of official engineering drawings, and fabrication the structure.

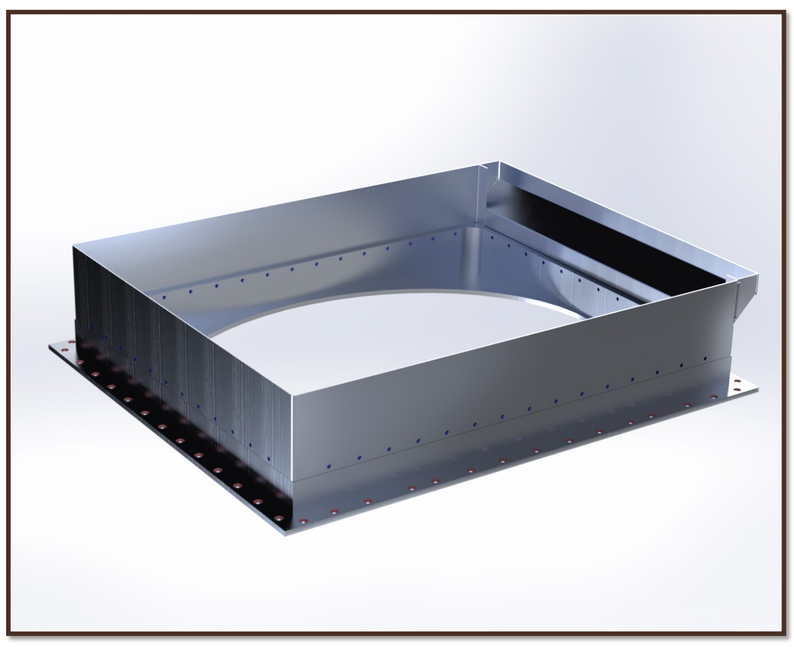

Figure 2: Lower portion of the mounting structure used to connect to the aircraft's nadir flange

Current Progress

Initially, a conceptual design was created to provide a visual representation of the project, enabling the exploration of weight reduction methods and evaluation of various assembly options. Following a preliminary design review, several additional concepts were modeled to fine-tune details and align the structure with client specifications. The current WCR4 lower antenna mounting structure is designed with both a lower and upper structure. The upper structure will attach to the aircraft seat tracks and the lower structure will attach to the nadir flange. The entire structure will be made from 7075-T6 aluminum alloy adhering to Aerospace Material Specifications (AMS). Stainless steel fasteners will be used to join the components, meeting either AMS certification or Military Specification standards. The primary load-bearing structure is made of aluminum square tubing that surrounds an aluminum plate enclosure. These plates will be coated with some radiation-absorbing material. Inside the plate enclosure will be an additional square tubing structure to mount and position the two antennas. The lower structure will be a machined flange plate with aluminum sheet sides.

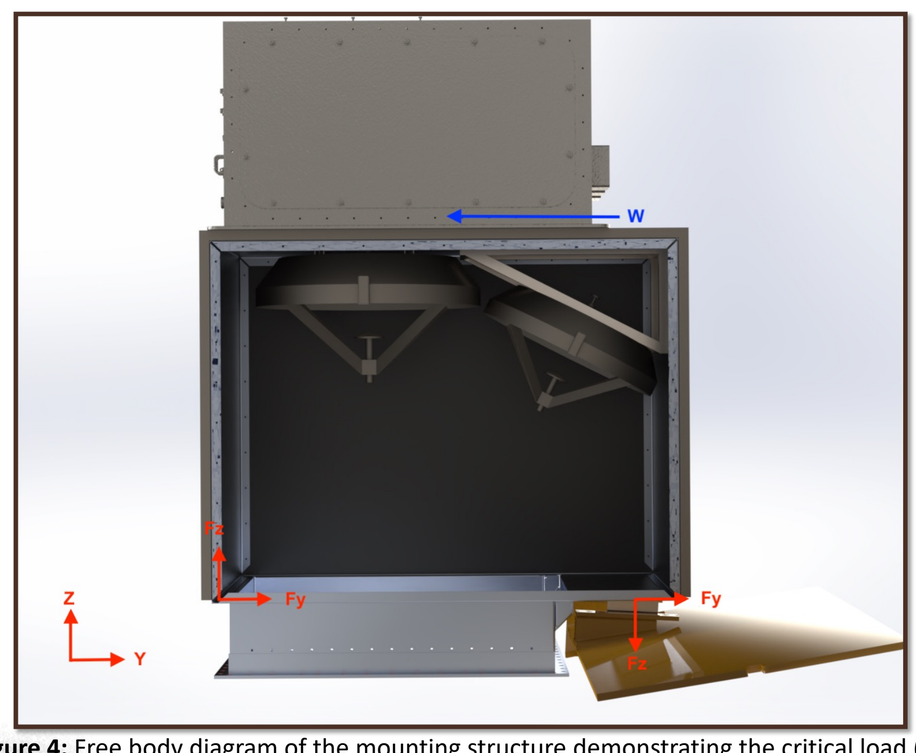

Figure 4: Free body diagram of the mounting structure demonstrating the critical load (Blue) and corresponding reactions (Red).

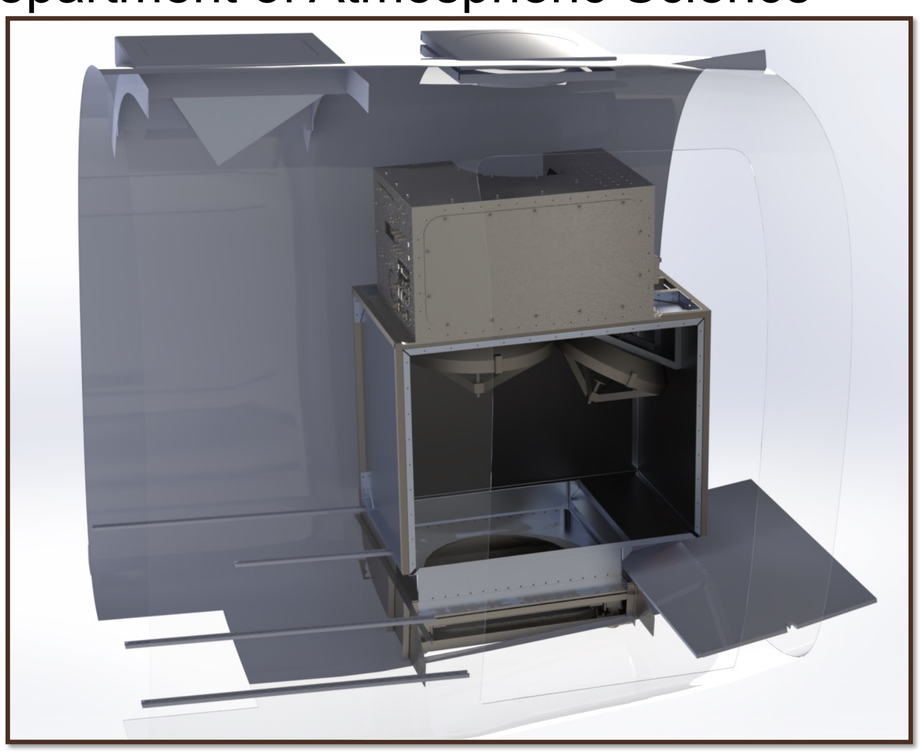

Figure 1: Full assembly shown within the aircraft

Design Requirements

- WCR4 will be positioned within the aircraft with allowances made for an adequate interface with all four antennas.
- The structure will position the two lower antennas strategically to allow them to transmit and receive signals through the nadir (downward facing) port with one facing straight down during flight and the other angled at a 33-degree forward slant.
- The inner structure must be light-tight to prevent radiation leakage from the lower antennas.
- All parts must be fabricated from traceable, aerospace-grade materials and fasteners.
- The structure will connect to the aircraft's seat tracks and nadir port
- The structure must be modular to permit easy installation and removal.
- The entire structure must have demonstratable compliance with all applicable FAA regulations.

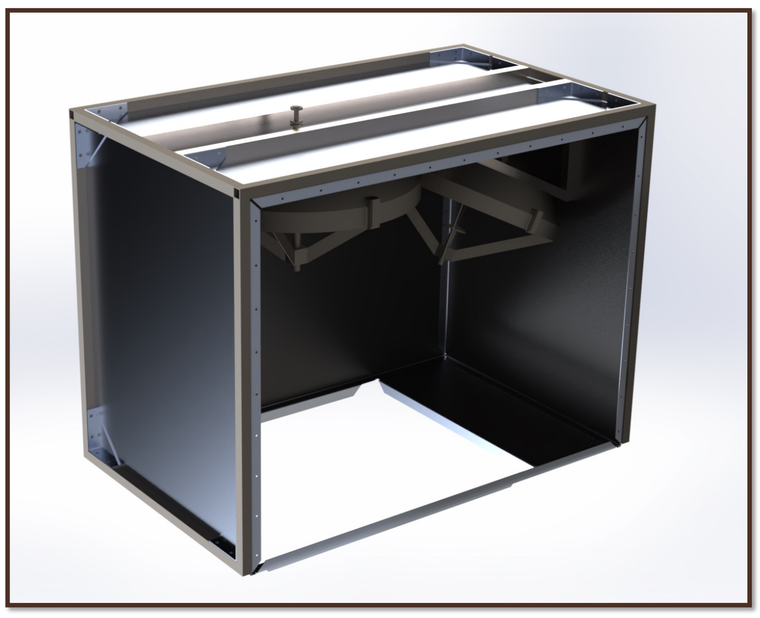

Figure 3: Upper portion of the mounting structure used to position the radar and antennas, and connect to the seat tracks

Going Forward

A critical design meeting will be held with the client to determine which design the team will move forward with. After a design is selected, the next phase of the project will focus on writing the structural stress report. Much of the time will be spent performing critical load and stress state calculations on the structure to demonstrate compliance with the applicable FAA regulations and ensure all client requirements are met. The structural stress report will then be submitted for review. After the report has been approved, base materials and stock components will then be purchased. These materials will then be provided to the Atmospheric Science Department's machine shop, in addition to SolidWorks drawings of the assembly and parts, to allow for the fabrication of the structure. After which the structure will be installed on the aircraft.