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Arctic Aeroponics System Stress Analysis

- The Arctic Aeroponics System's bottom base is subject to severe loading conditions including the weight of 6-gallon water tank. It is held up by 5 feet support which raises the system above the ground to give it a layer of air as insulation from the permafrost ground.
- Identified the need to analyse stress levels in the bottom base, and led and designed the stress study
- No symmetry was identified, therefore to reduce computational load, critical zones were identified (as seen in Figure 2), which were given lower mesh sizes
- Conducted H-refinement and P-refinement to select the mesh size of 50 mm for the critical zones, and to select quadratic elements for the analysis
- Decreased the thickness from 2" to 3/16" reducing the weight by 90% which increased the stress level by 2291.45%. But the stress was only 20.62% of the yield stress. The inital thickness was found to be too big.

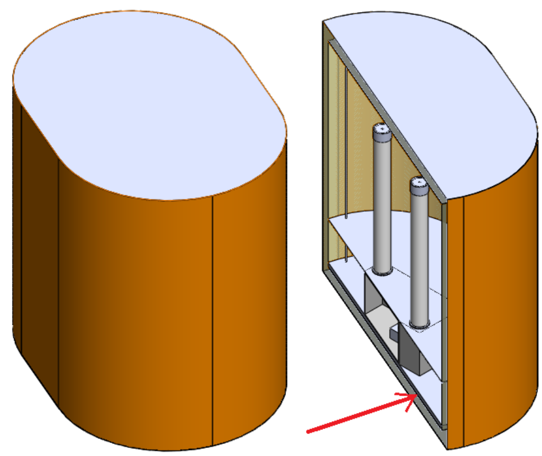


Figure 1: Main System with the base plate shown by the arrow

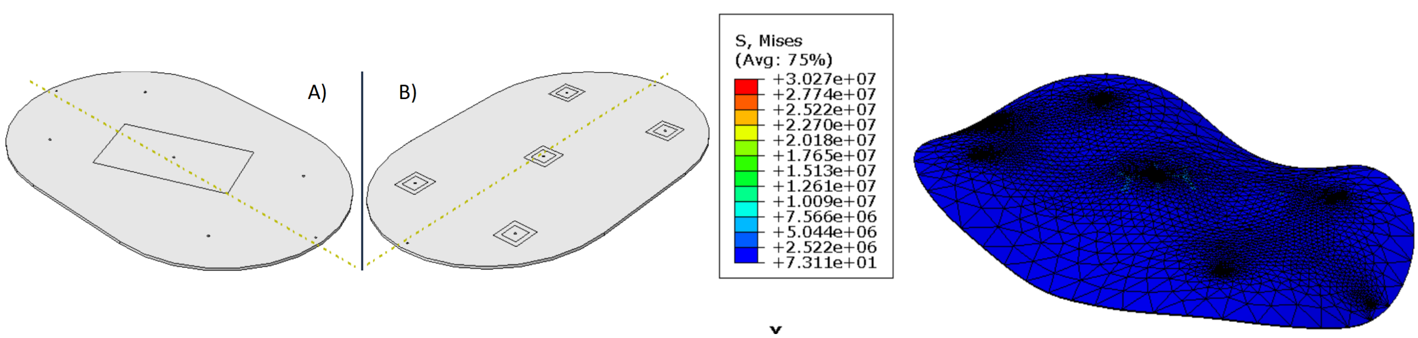
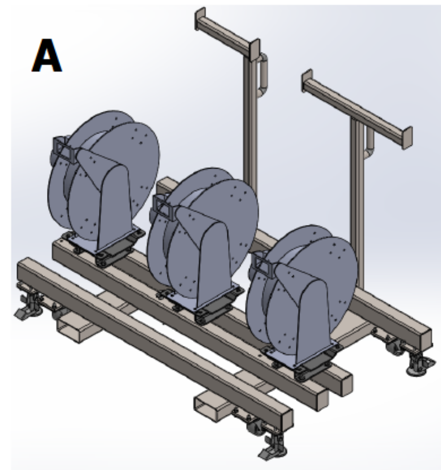
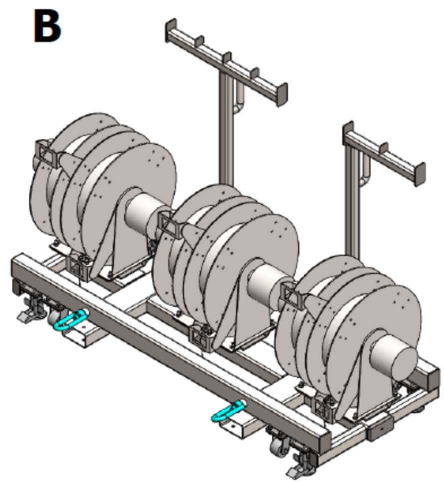


Figure 2: Critical Zones in the Plate and FEA of the final part

Cable Management System

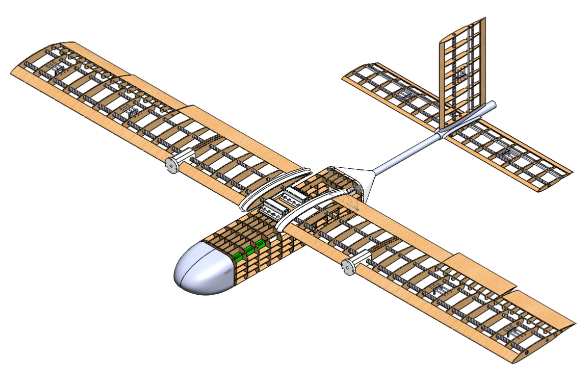
- Designed a new cable management system (B) to replace the original cable management solution (A), in order to increase the number of cable reels it can house from 3 to 6
- Analysed different cable reel configuration combination in order to minimize space and cost of the system
- New design was **25% cheaper**, **49% smaller** and **38% lighter**, with a **100% increase** in the cable capacity
- Conducted 4 FEA studies to minimize deflection in the new design from the load of 6 cable reels
- Conducted tipping calculations ensuring the system can withstand the tension forces from the cables without the system tipping over



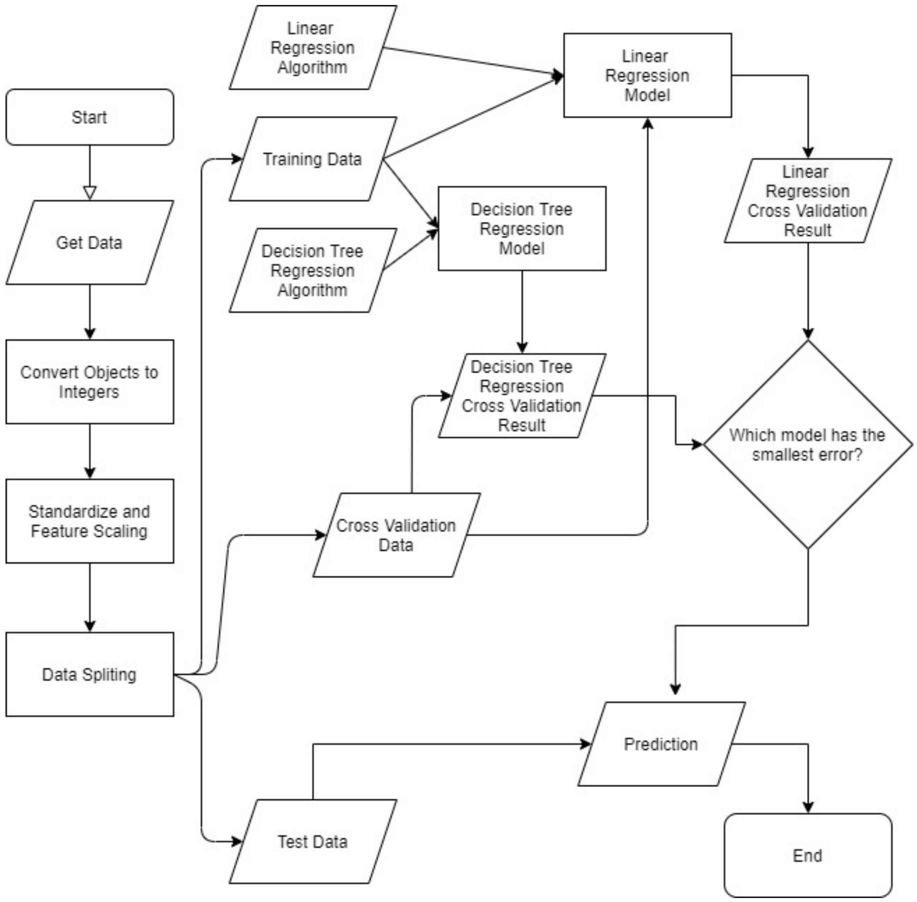


Critical Connectors for Project Boreas

- Independently drove the design process to develop critical parts for the wing and the tail assemblies such as wing connector, tail connectors and motor mount
- Independently developed and implemented tests to verify the parts met specifications identified early in the design process
- Conducted FEA studies to optimize stress and weight in the connection parts, **decreasing the weight by up to 15%**
- DFM and DFA for materials: PET thermoplastic, 6061 Aluminum, rubber, and carbon fiber; using fabrication methods: laser cutting, machining and, FFF/FDM and SLA 3D printing



Predictive Machine Learning Model for 3D Printing Material



- Designed a predictive model for 3D Printing material using print settings through Machine Learning
- Performed data pre-processing, including converting object data-type to integers data-type, standardization, feature scaling and data-splitting
- Trained and validated Linear Regression and Decision Tree Regression models in order to choose the best model
- Implemented the model, resulting in the model predicting the validation set with an accuracy of 94.4%

Arctic Aeroponics System Plant Growth Space

- The plant growth space was designed to take in water from the bottom inner tube opening and spray water on all four directions on the inner walls of the growth space. The excess water would trickle down the inner wall and down the funnel back into the tank.
- Led the design process to create a plant growth space, while maximizing plant per volume of the growth space
- Designed the growth space with principles of DFM and DFA, taking into account the logistical challenges of the supply chain during Covid pandemic
- Design made to be modular, with plant growth space being interchangeable, while be easily disassembled and cleaned
- Selected PVC and aluminum parts to ensure no toxic seepage into the plants