M2.02 – 3-Axis Composite Filament Winder

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BOBCAT AEROSPACE

Problem Statement

Student teams (e.g., Bobcat Aerospace) need lightweight, high-strength composite parts.

Currently, they must outsource or use manual and time-consuming methods, limiting iteration and increasing cost.

Producing parts in-house improves flexibility, reduces cost, and enables tailored fiber layups for strength-to-weight optimization .

Project Description

A 3-Axis Composite Filament Winder (CFW) is an CNC machine which can fabricate axisymmetric parts using the controlled deposition of continuous filaments called tow.

This semester addresses shortcomings from semester 1 by improving rigidity, redesigning the tow path and resin-wetting components.

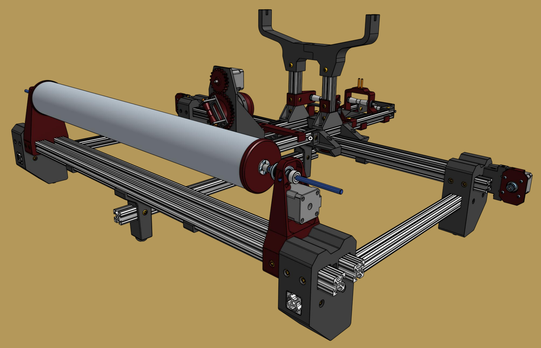
Work culminates in validating the machine through winding trials before handoff.

Background

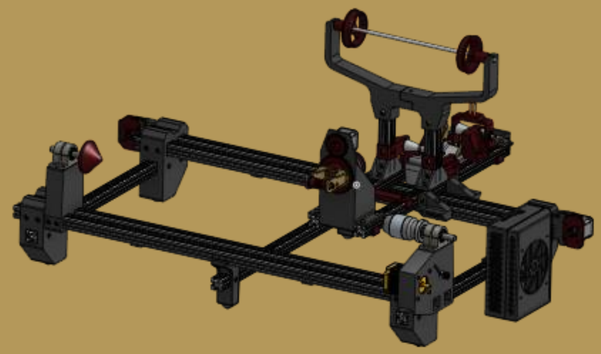
This project builds upon the open-source filament winding machine developed by Andrew Reilley, who created a low-cost and accessible approach to composite manufacturing.

From the original concept, we significantly improved and redesigned components for use in a teaching and research environment.

Developments From Semester One

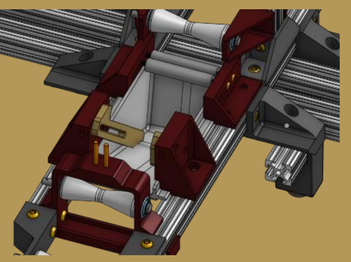


Semester 1 Design

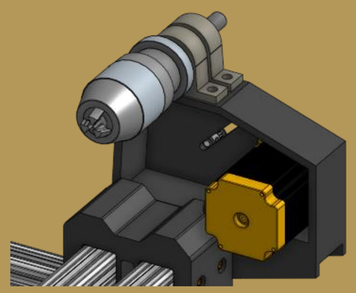


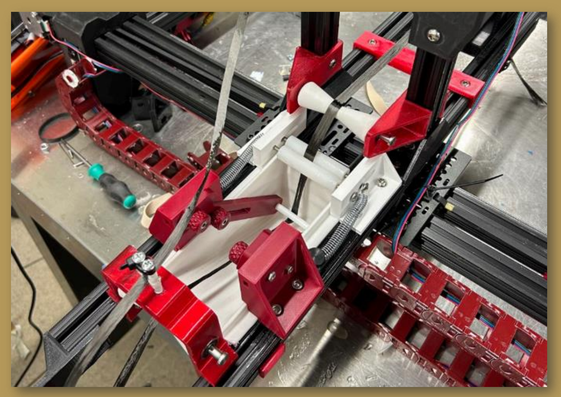
Semester 2 Design

New Mandrel Holding System



Improved Tow Path Ergonomics





Future Work

Future work may focus on integrating a 4th axis to improve tow placement accuracy and enable more complex winding geometries. Additional plans to upgrade the control system by moving beyond the current Cyclone workflow and adopting advanced winding software such as CADFil or TaniqWind. Lastly, use-specific training for student use will be developed for safe and reliable usage.

Key Improvements

Fiber Impregnation	Movement Rigidity	Motors
Too much resin to fiber fraction	Printed kinematics added slop.	Use of NEMA 17 motors caused stalling
Addition of compliant squeegees	Commercial "V-plates"	Upgraded to NEMA 23 – higher torque.

Meet The Team

Left to right:
Hunter Kelly, Sandy Hernandez, Everest Sweet

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