SIDEWINDER

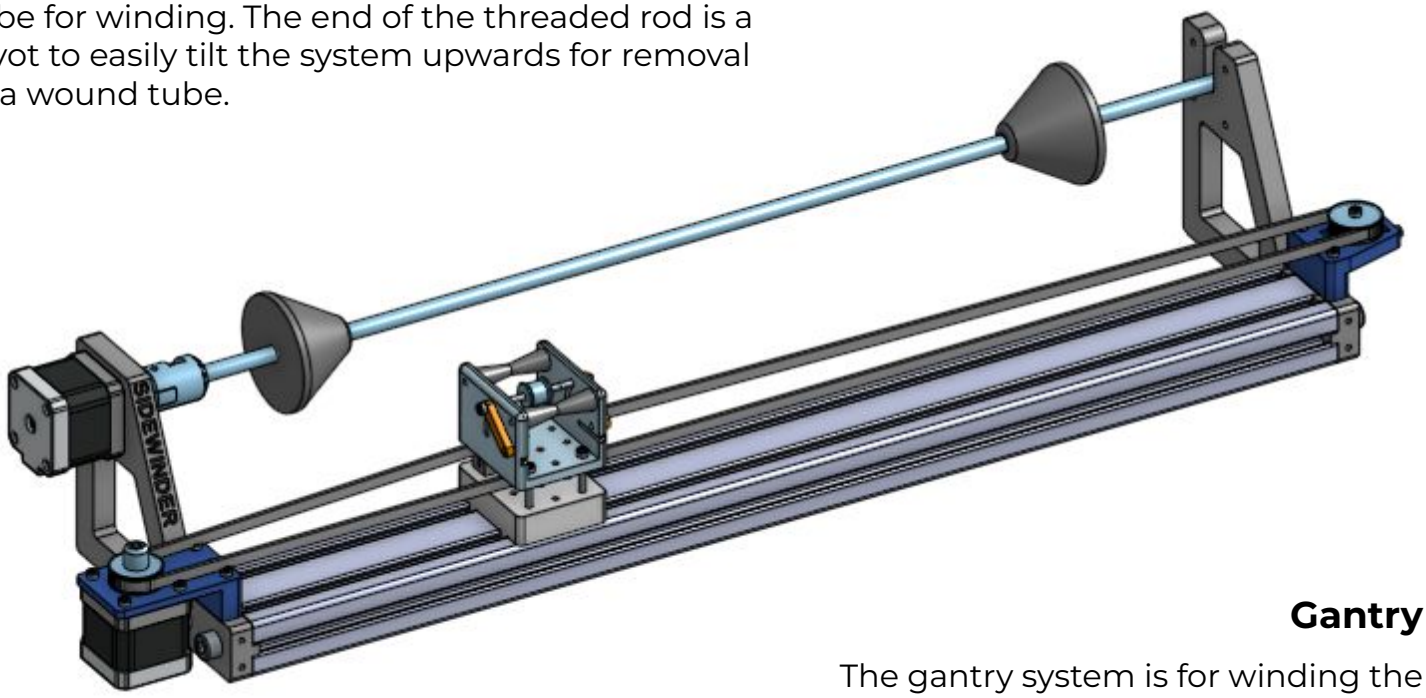
Carbon Fiber Tube Winding Machine

Final Paper CAD Model

Technical Sheet

Mandrel Interface

To accommodate a wide range of diameters and lengths of tubes, the mandrel core is a threaded rod that holds two conical clamps that center the tube for winding. The end of the threaded rod is a pivot to easily tilt the system upwards for removal of a wound tube.

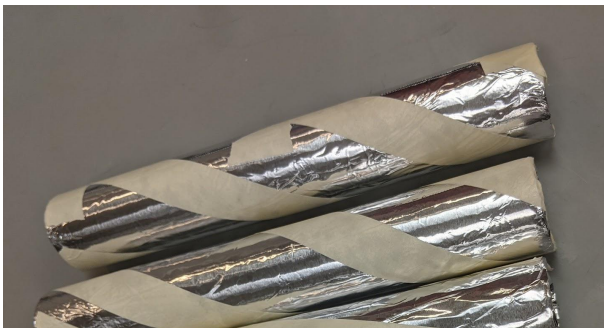


Gantry

The gantry system is for winding the carbon fiber tow in a specific pattern, by moving it sideways as the mandrel spins. The gantry is comprised of a 30/60 aluminum extrusion with a belted carriage on top. The carriage is constrained to move along the extrusion and is driven by the stepper motor through a timing belt.

Control/Drive

The machine is driven by 2 NEMA 17 stepper motors, one for the gantry and one for the mandrel. They are controlled through an arduino and two adafruit stepper drivers. The control system also features a display to see the current progress, and a push button to pause or stop the machine in case of problems.



Mandrel

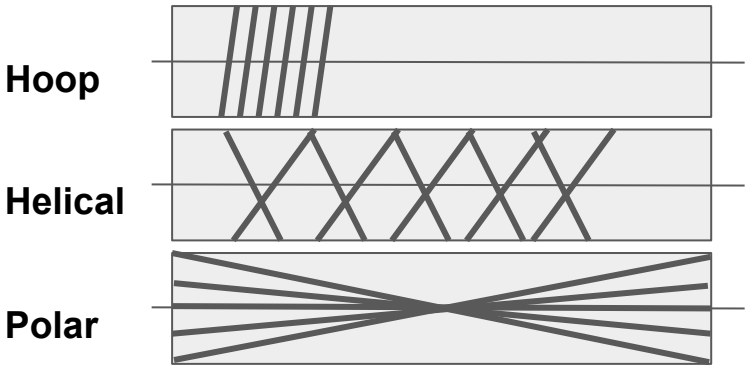
The mandrel that the carbon fiber is wound on is a thick cardboard wrapped in wax paper, and then aluminum foil. The aluminum foil can easily slide off the wax paper after the fiber is cured, and the aluminum then easily detaches from the carbon fiber meaning the cardboard and wax paper can be reused indefinitely.

Winding Process

The machine is designed to dry wind. A mandrel is clamped to the mandrel interface and carbon fiber tow is threaded through the gantry carriage and taped to one end of the mandrel. The process is then started and the machine winds a predetermined pattern involving hoop and or helical layers. The tow is then cut, taped, and the mandrel is then removed from the machine. Epoxy (West Systems 105 + 209) is coated onto the carbon fiber tube (in tests, it sinks through and successfully covers all fibers). To speed up curing, the mandrel is left in an oven at around 70C for 24 hours. The mandrel is removed and the process is complete.

Completed Tubes

Types of Winds



Please see Final Paper for results and further details