portfolio.

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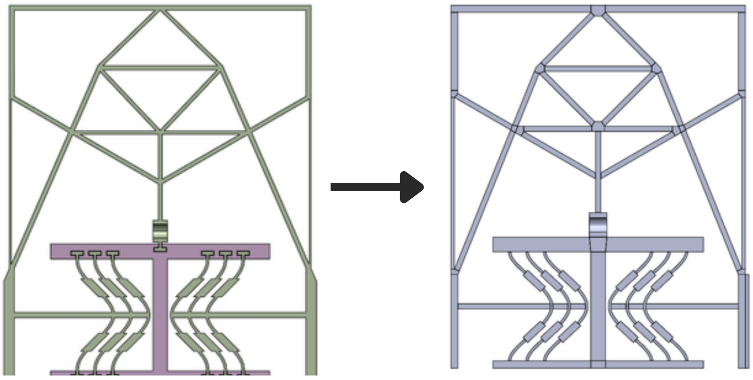
MECHANICAL ENGINEERING

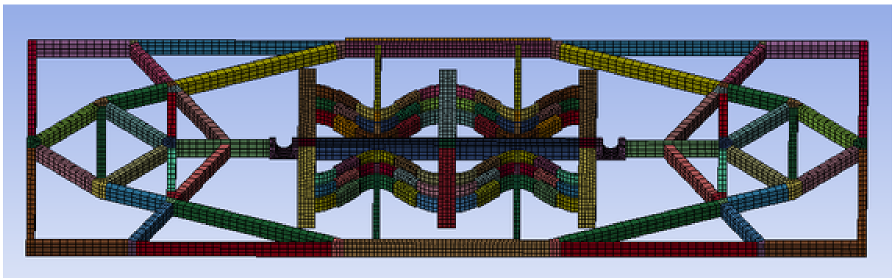
PARAMETRIC FEA OF MULTISTABLE COMPLIANT BUILDING FAÇADES

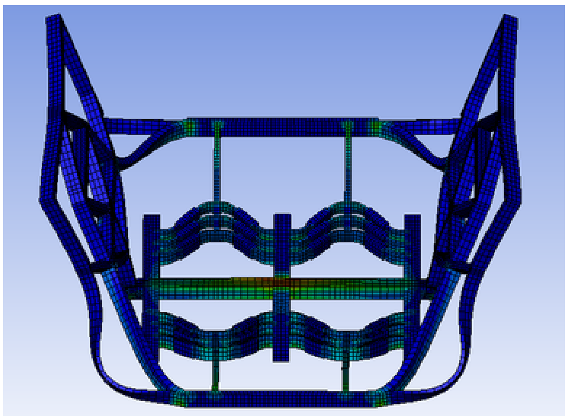
PROJECT STAGES

CAD CLEANUP AND PARAMETRIZATION

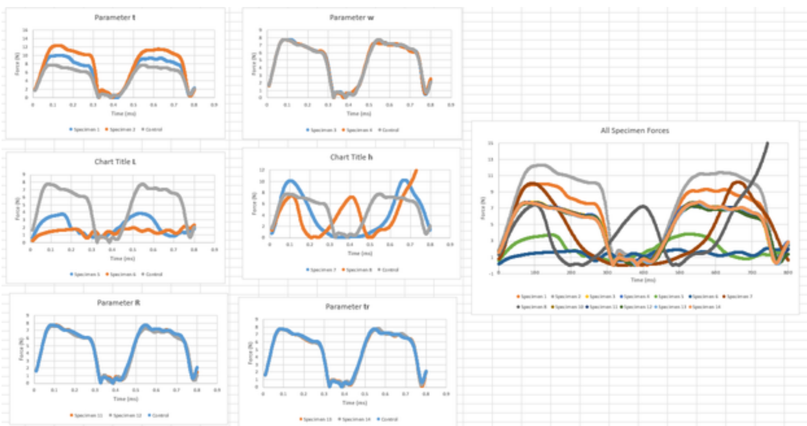


EXPLICIT FEA SETUP AND ANALYSIS





DATA ANALYSIS AND COMPARISON OF ALL 13 SPECIMEN



SKILLS

SolidWorks

Ansys Mechanical

LS-DYNA

MATLAB

MS Excel

PROBLEM

Structures with bi-stable behavior are extremely sensitive to small geometric changes. Mapping out how geometry drives response by testing physical specimens alone is expensive and slow, and without a validated numerical model there's no quick way to know how a new design will behave before you print and test it.

SOLUTION

Converted the idealized bistable-beam geometry into an FEA-ready parametric model that could be solved on a consistent basis. Built the FEA model to solve the nonlinear, large-deformation transient problem needed to capture the force-displacement curve. Extracted the reaction-force output mimicking the real experimental setup, processed it, and compared it directly against the physical test data.

IMPACT

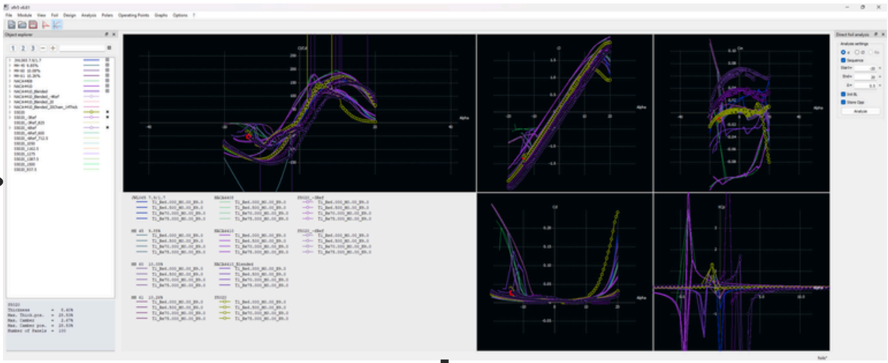
The FE model matched the experimental force-displacement curves closely, which gives the team a validated way to predict bistable behavior, without the need to fabricate and test a new physical specimen for every design variant.

UAV PROTOTYPING FRAMEWORK

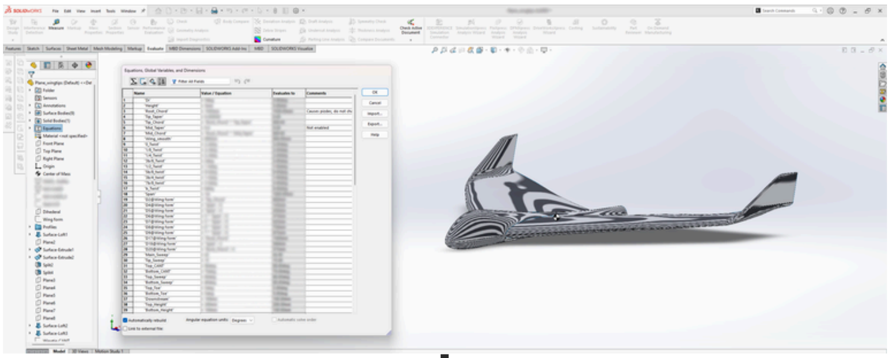
(SOME PARTS ARE BLURRED INTENTIONALLY FOR NDA PURPOSES)

PROJECT STAGES

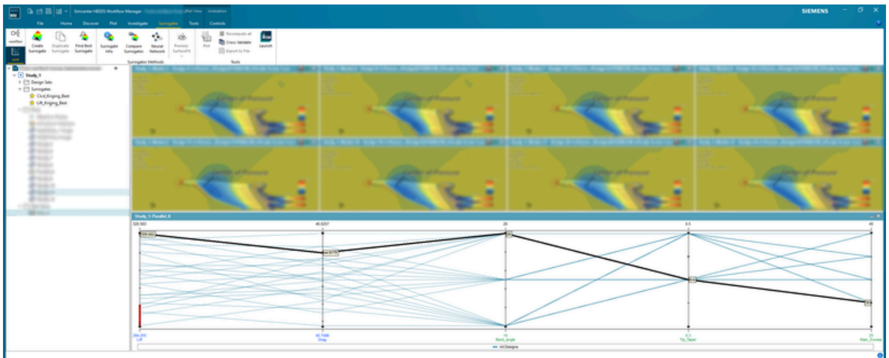
PRELIMINARY AIRFOIL ANALYSIS



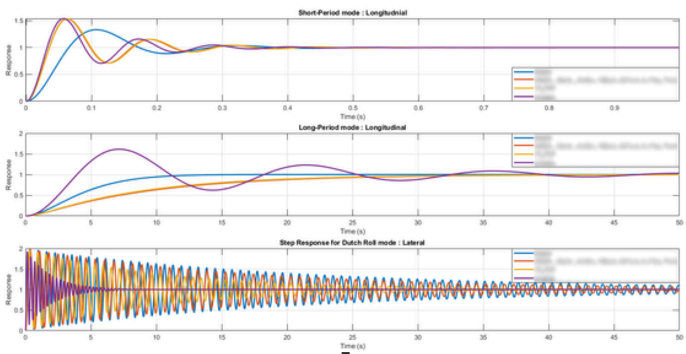
PARAMETRIC CAD MODEL



MODEL OPTIMIZATION



STABILITY ANALYSIS



SKILLS

SolidWorks

STAR-CCM+

Ansys Mechanical

MATLAB

xflr5

HEEDS

Design for Manufacturability

PROBLEM

Traditional UAV prototyping is costly and time-consuming, relying on physical build–test–crash cycles that slow down iteration and increase expenses.

SOLUTION

Conducted a preliminary airfoil analysis using XFLR5. Developed a parametric flying-wing UAV design in SolidWorks, integrated with Star-CCM+ and HEEDS for automated optimization of wing geometry (span, twist, sweep). Conducted aerodynamic and stability analyses using Star-ccm+ Design Manager, then created MATLAB state-space model to assess flight stability. Optimized structural design in ANSYS Mechanical for manufacturability and material efficiency.

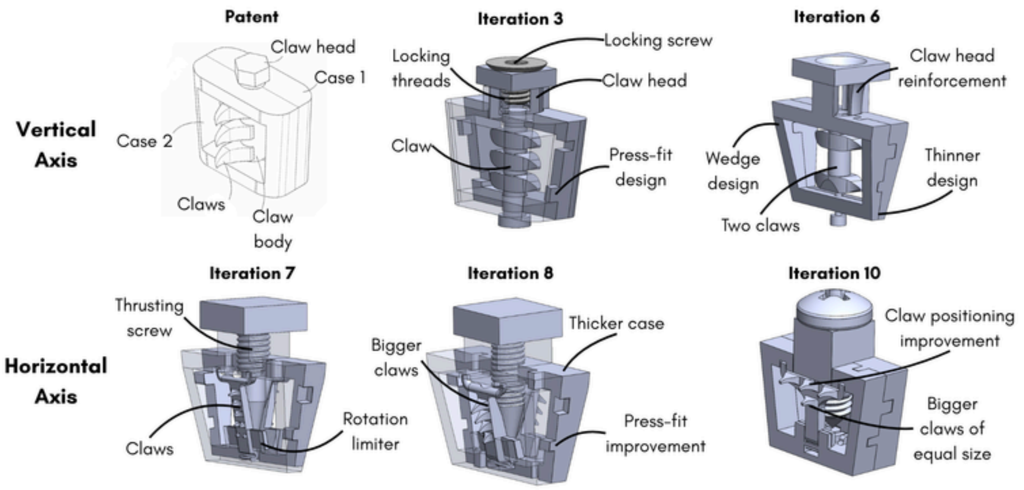
IMPACT

Completed and validated a UAV prototype in 3 months, significantly reducing development time and cost compared to standard methods, while creating a reusable, automated workflow adaptable to future UAV models.

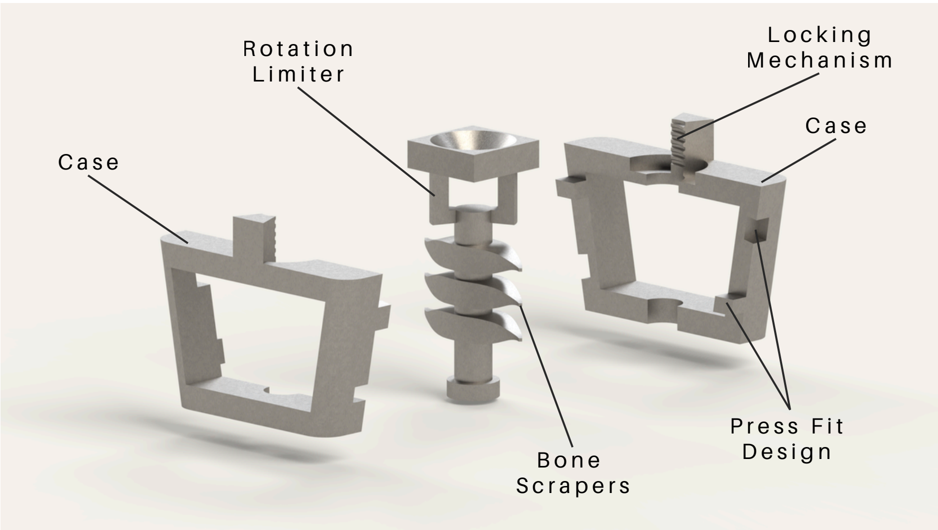
BIOLOGICAL IMPLANT

(EARLIER ITERATION ANALYSIS IS SHOWN AS THE LAST ITERATION IS BEING PATENTED)

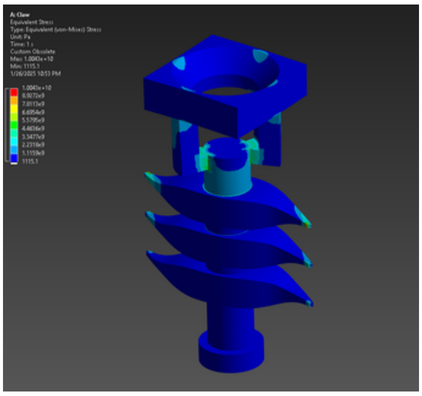
IMPLANT ITERATIONS



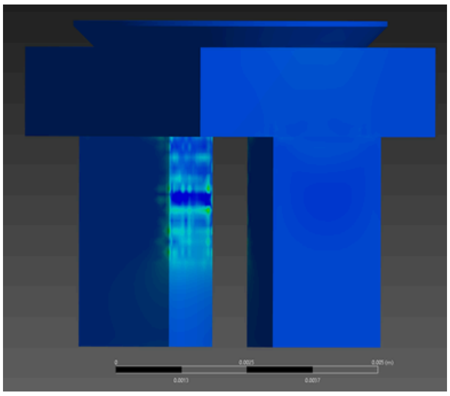
EXPLODED VIEW OF ITERATION 3



TORSIONAL ANALYSIS



THREAD PRELOAD ANALYSIS



SKILLS

SolidWorks

Ansys Mechanical

Design for Manufacturability

PROBLEM

Spinal implants require stable fixation between lumbar joints, but existing solutions are limited by manufacturing constraints, insertion size and uncontrolable remission of the vertebrae.

SOLUTION

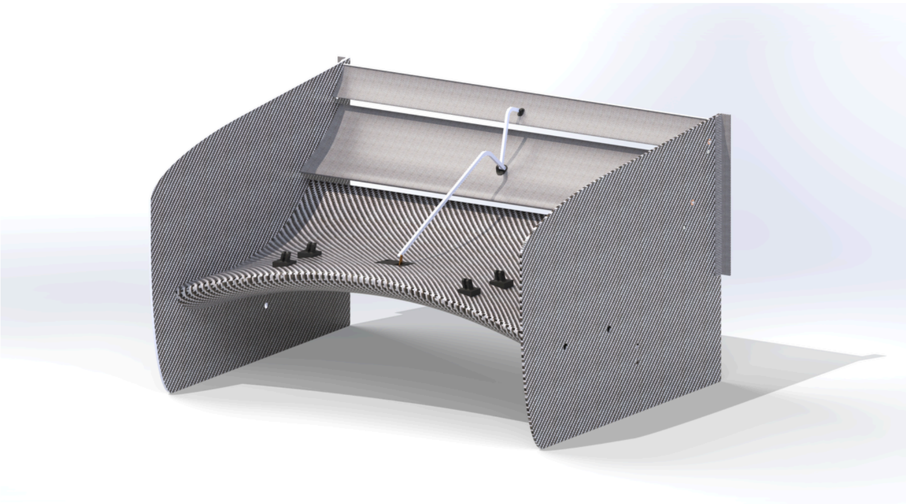
Designed an implant with a rotatable claws, locking mechanism, and press-fit design. Used SolidWorks for design, and validated with torsional and thread preload analysis in ANSYS. Manufactured using Direct Metal Laser Sintering (DMLS) and CNC milling for the threads.

IMPACT

Enabled secure fixation on the tip of a finger-sized inserter while accommodating critical size limits. The Prototype demonstrated manufacturability and went through validation testing on a cadaver. The work on the new iteration is on the way based on the data collected in the testing.

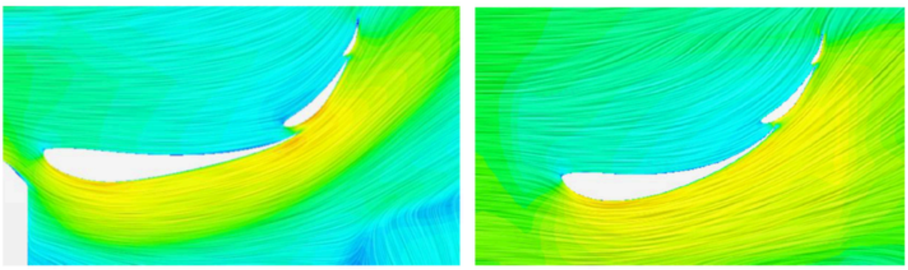
FSAE CURVED REAR WING DESIGN

CAD VIEW

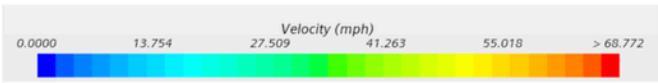


ANALYSIS

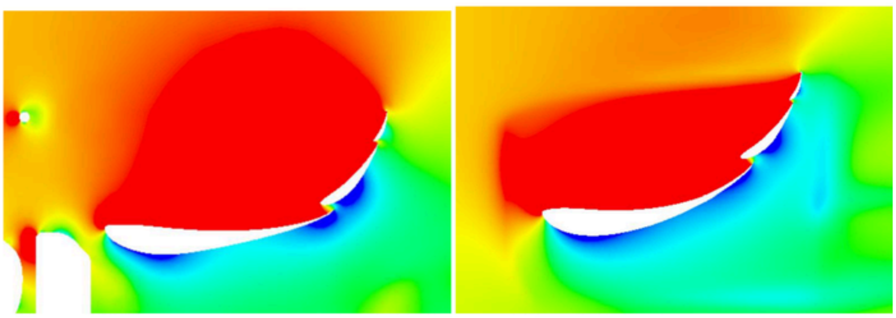
Rear Wing Velocity Line Integral Convolution



Centerline (S-1223 Main Element) *Wingtip (MSHD Main Element)*



Rear Wing Pressure Gradient



F24 Centerline (S-1223 Main Element) *F24 Wingtip (MSHD Main Element)*

SKILLS

SolidWorks

STAR-CCM+

Fusion 360

MATLAB

Design for Manufacturability

PROBLEM

New rule changes placed the driver's headrest in the airflow path, requiring a rear wing redesign that could maintain aerodynamic balance. The wing also needed to generate sufficient downforce to counteract the front wing while avoiding flow separation across multiple speeds.

SOLUTION

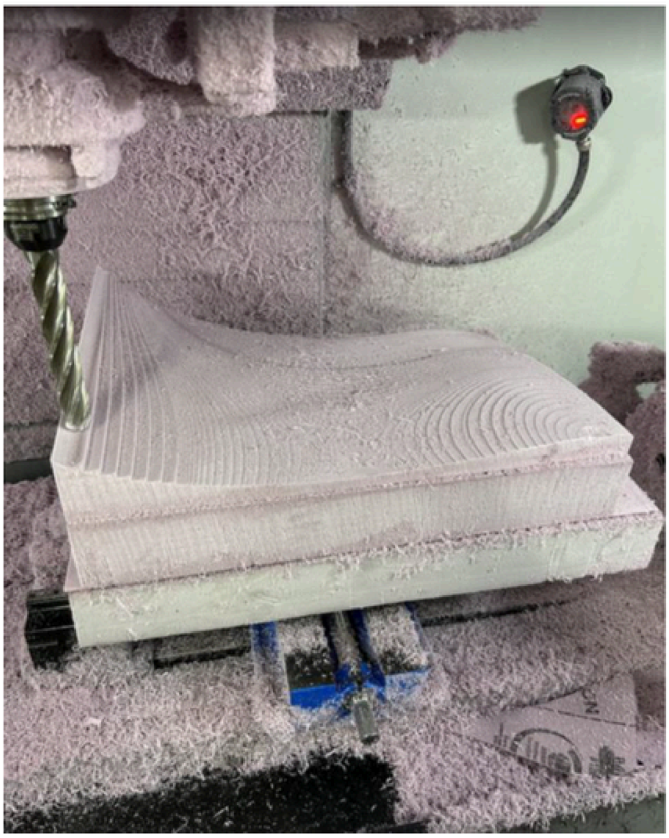
Modeled a three-element cascading rear wing in SolidWorks. Used Star-CCM+ with Design Manager to run CFD analyses and optimize element placement for six design speeds. Implemented a 3D curved main element to route airflow around the headrest, transitioning from high-camber airfoils at the edges to lower-camber airfoils in the center.

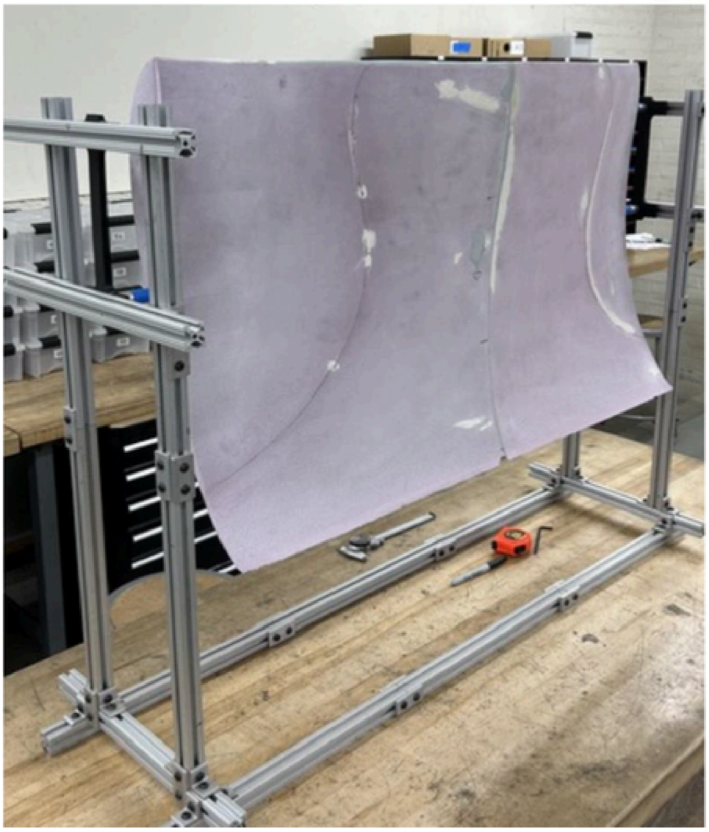
IMPACT

Created a regulation-compliant, optimized rear wing that maintained efficiency and stability, shifted the center of pressure rearward, and improved overall aerodynamic balance and vehicle performance.

FSAE REAR WING MANUFACTURING

MANUFACTURING SNAPSHOTS





MOUNTED ON THE CAR

PROBLEM

The rear wing's 3D curvature, designed to clear the driver's headrest and interact with cleaner airflow, created manufacturing challenges.
A drag-reduction solution(DRS) was also required to balance performance at high speeds.

SOLUTION

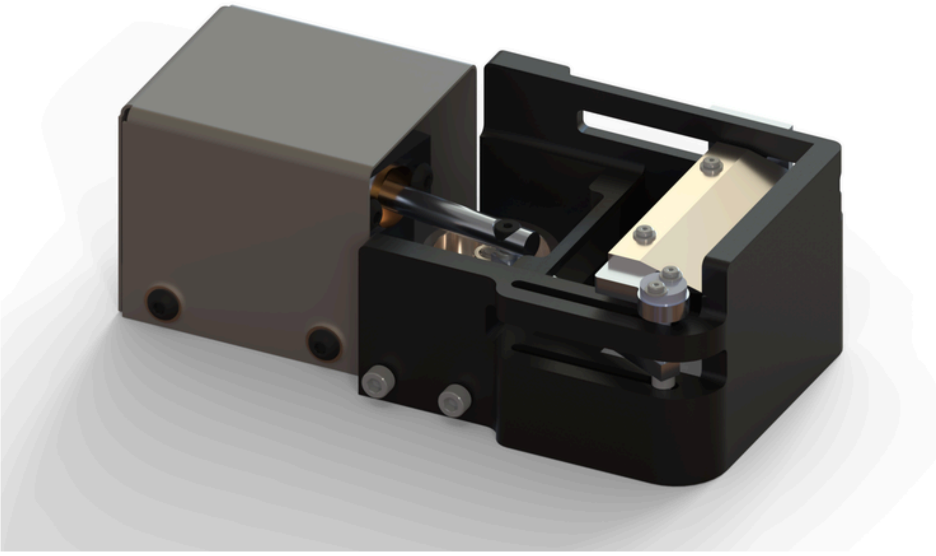
Implemented a DRS system to minimize drag when downforce was not needed. Modeled CNC toolpaths in Fusion 360 to machine two halves of a male mold (instead of traditional male + female molds) for the carbon fiber layup. The mold was suspended for one-piece wrapping, and peel ply was applied during vacuum bagging to replace Mylar.

IMPACT

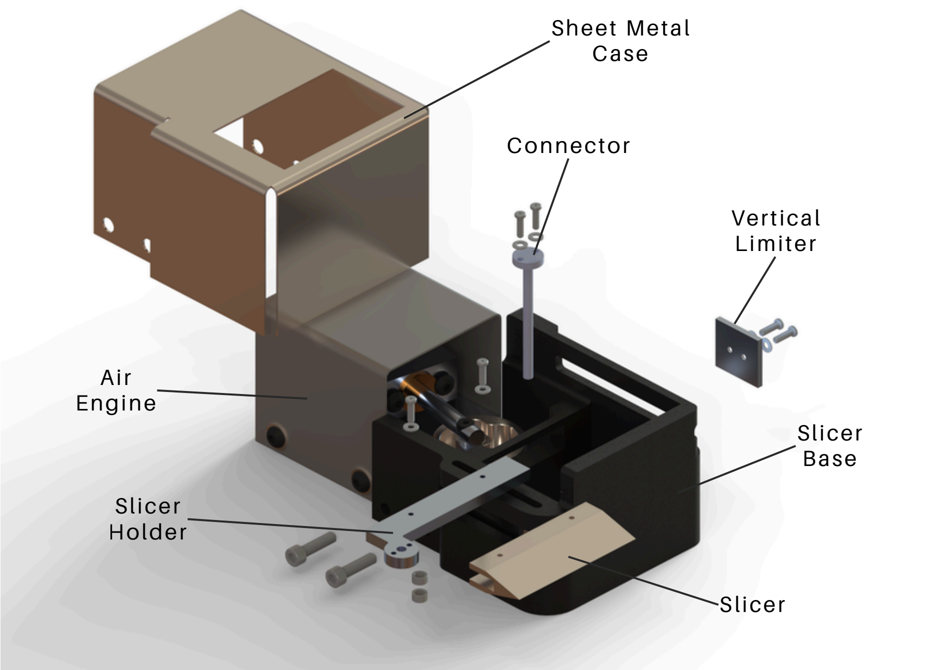
Achieved a cost- and time-efficient manufacturing process for the 3D curved rear wing, while maintaining aerodynamic performance and compliance with racing constraints.

FRUIT/VEGETABLE SLICER

CAD VIEW



EXPLODED VIEW



MATERIAL SELECTION

Material selection prioritizes durability, machining ease, and weight efficiency. While the slicer base is 3D printed from PETG to accommodate its complex geometry, the connecting arm, transfer arm, blade holder, and limiter are all machined from 6061 aluminum for improved rigidity and reduced weight. The cutting blade itself is fashioned from 304 stainless steel, offering both excellent corrosion resistance and straightforward maintenance.

SKILLS

SolidWorks

MS Excel

PROBLEM

A precise and stable slicing mechanism was needed to convert rotational energy from an air engine into controlled, linear cutting motion without introducing unwanted rotation or misalignment.

SOLUTION

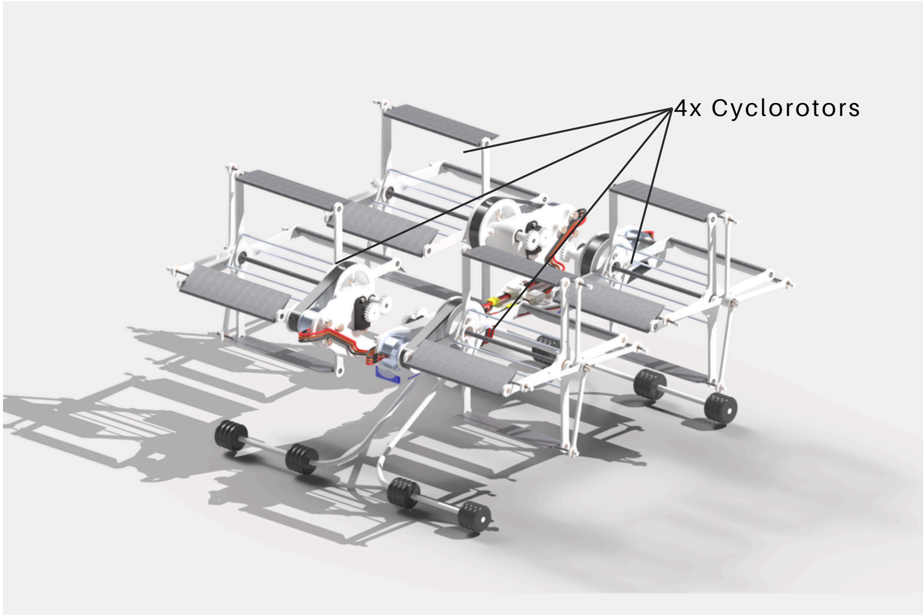
Designed a mechanically driven slicer using a linkage system. A transfer arm connected the flywheel to a guided connecting arm constrained within linear slots in a 3D-printed PETG base. This motion drove a blade mounted in a holder with hex screws, while a limiter ensured stability. The assembly was secured to the air engine base with a four-screw attachment.

IMPACT

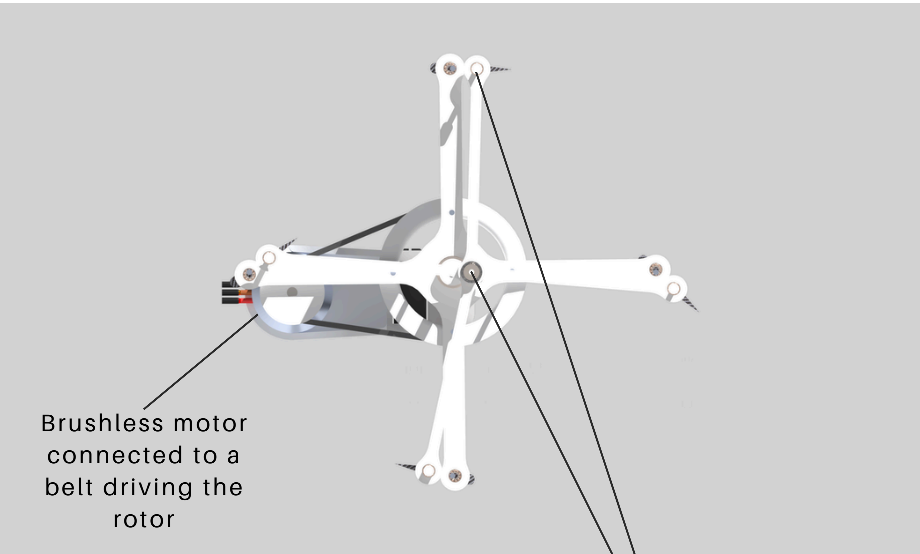
Delivered a reliable slicer mechanism with accurate linear blade motion, demonstrating effective conversion of rotational energy into controlled cutting action.

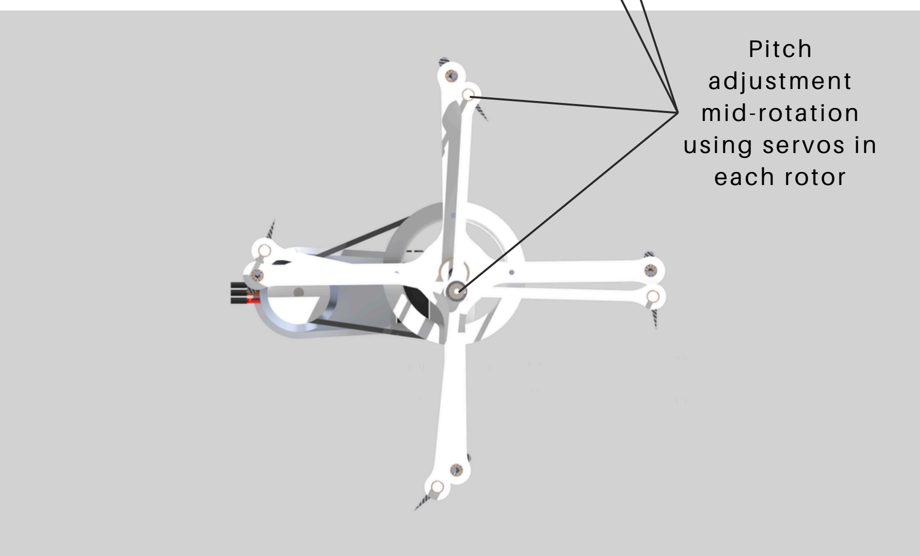
CYCLOCOPTER

CAD VIEW



CYCLOROTOR VIEW





SKILLS

SolidWorks

SolidWorks|Visualize

PROBLEM

Final project required a complex mechanical design. I chose to build a cyclocopter UAV — a novel rotorcraft concept — consisting of 400+ parts and 60+ unique components.

SOLUTION

Designed a four-rotor cyclocopter in SolidWorks with pitch-adjustable carbon fiber blades and an offset linkage enabling asymmetric blade pitching for lift and thrust vectoring. Managed a large-scale assembly and rendered the design in SolidWorks Visualize for professional presentation.

IMPACT

Delivered a fully detailed cyclocopter UAV assembly that demonstrated advanced CAD skills, aerodynamic functionality, and the ability to manage and present large, complex mechanical systems.