PORTFOLIO

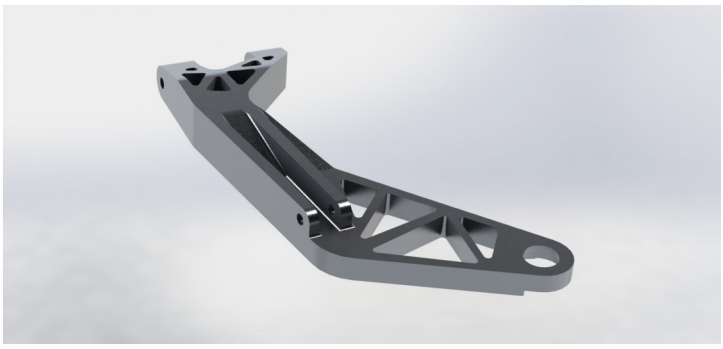
Midnight Sun Solar Car Team

The Midnight sun solar car team is a student run design team based at the University of Waterloo. First, I joined the aerodynamics team and have since diversified my involvement to include leading suspension design as well as assisting the composites, chassis, and brakes sub teams. Here are some of the things I have accomplished during my time on the team.

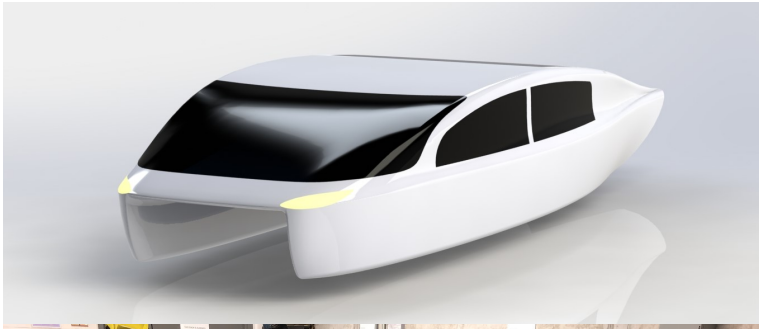
Front Suspension Design

In solar racing, where vehicle efficiency is paramount, packaging the vehicle as tightly as possible is advantageous for reducing aerodynamic resistance. I led the design of our front suspension. A leading arm configuration with a pushrod driven air shock was selected for its wheel scrub attributes and reduced frontal area.

Suspension geometry was carefully chosen based on tire data and desired handling characteristics. All components were created through analysis-driven design and validated by hand calculations and testing.



A key feature of the leading arm is a cut out on the outboard side to allow for steering. Balancing weight, strength and wheel travel made for a very fun design challenge

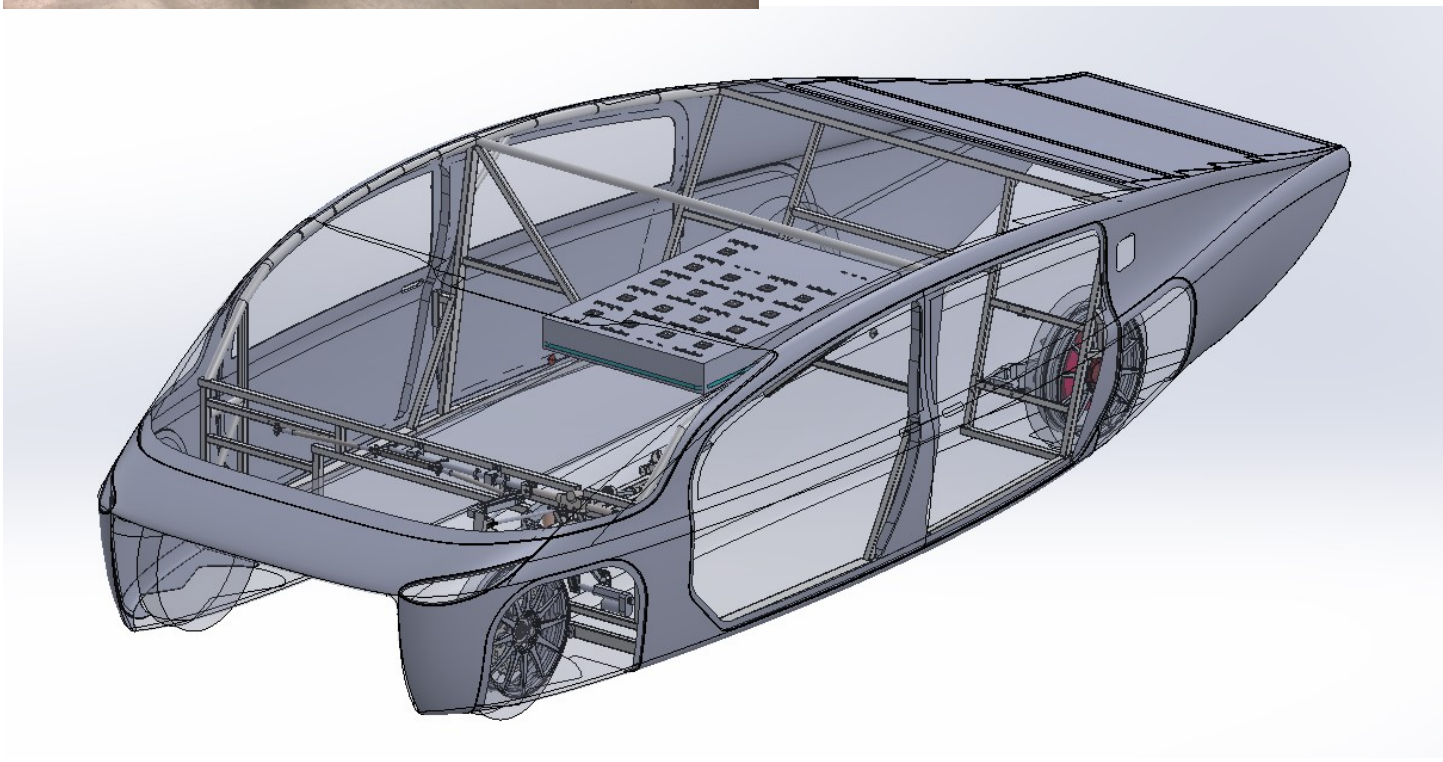


Aerobody and Chassis

I assisted iterating through various aerobody designs as well as conceptualizing low drag intakes.

For a solar car to participate in the American Solar Challenge, it must survive a 5g impact from 12 different angles as specified by regulations. Using ANSYS structural in conjunction with ACP pre/post, I helped iterate through these cases.

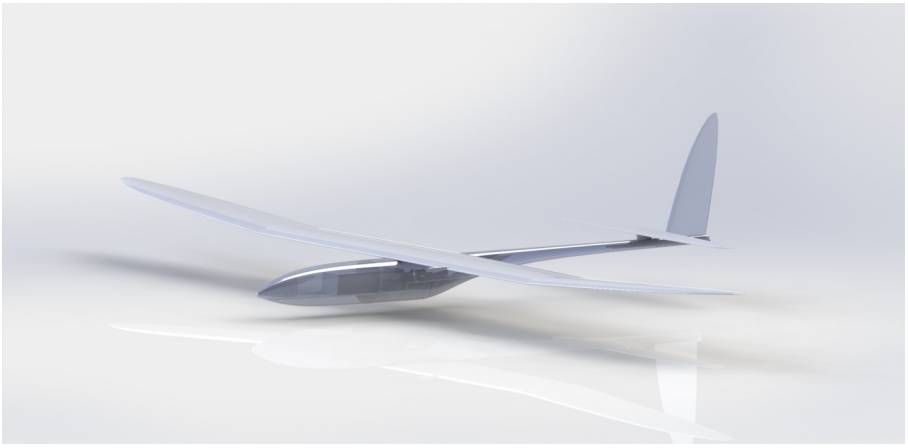
The chassis is a semi monocoque design with structural carbon fibre floor, front, and back panels. Research and lab testing (3 point bend, tensile, butted joint) determined the stackup.



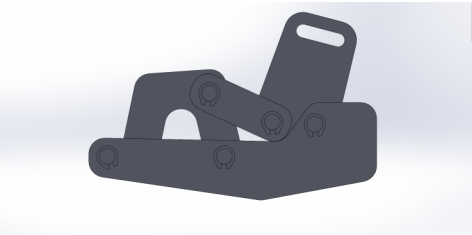
As the on-stream dynamics lead last year, I collaborated with other sub teams to ensure a smooth conception of the car. This was accomplished through hosting internal design reviews and check-ins, as well as communicating externally with hardware, and chassis teams. This ensured progress was shared throughout the solar car team. I overlooked component design ensuring every part had a directly responsible individual while also taking on high level design of the suspension system.

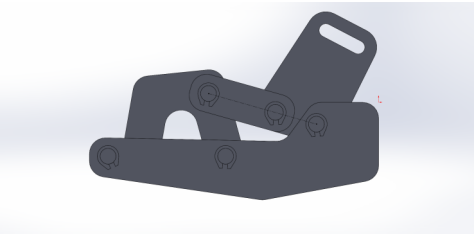
Stratodynamics Aviation

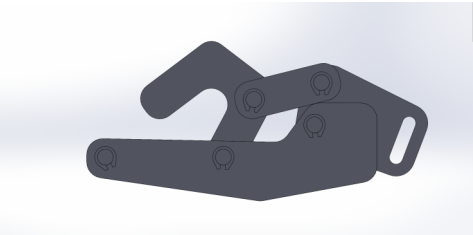
Stratodynamics Aviation provides high altitude flight services using a weather balloon-launched glider. I worked on developing the next generation glider which will have a maximum take-off weight of 12kg and fly at altitudes of up to 35km. My primary role was designing the mechanisms on the aircraft as well as creating a working model based on airfoils provided by a third party aerodynamicist.



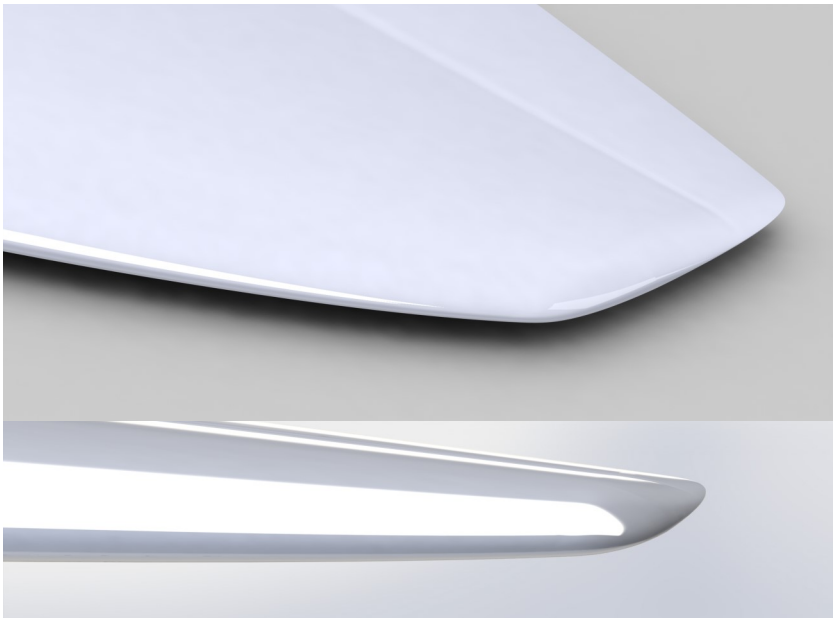
Release Mechanism Design







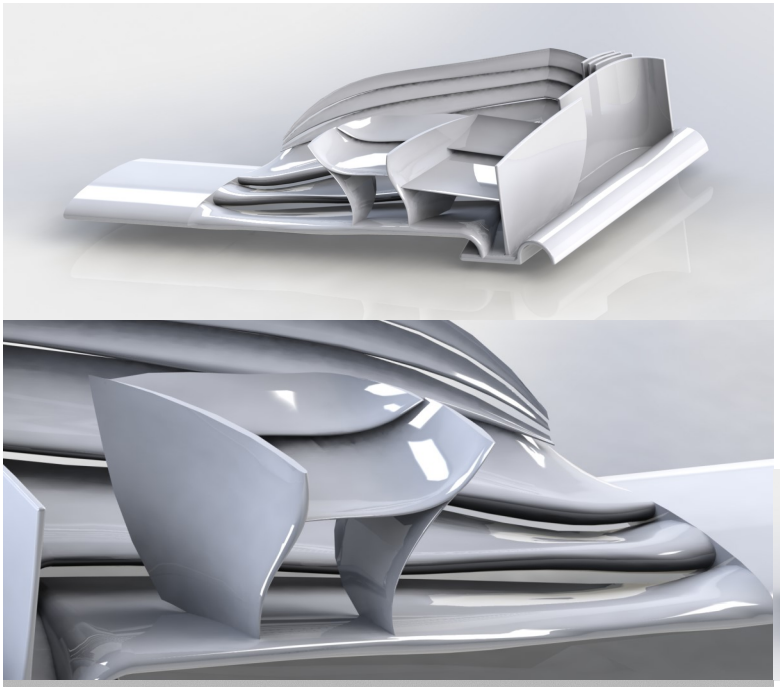
The Stratodynamics glider platform is designed to be released from a weather balloon. The interface between the two is a mechanical release hook and a loop. The prior designs suffered from icing and inconsistent release issues. I designed this 4-bar mechanism to alleviate these issues. The overcentre position of the linkage (leftmost image) directs forces away from the servo and into the baseplate. Once the mechanism progresses past the centre position (middle image), it is self opening. This ensures both a very strong closed state as well as quick opening without requiring significant force from the servo. To reduce weight, the mechanism is coupled to the same servo as the aircraft elevator. The slot allows for elevator motion during transit to the release altitude while ensuring the mechanism does not prematurely deploy. This motion prevents the elevator from freezing in place.



Surface Modelling

One of my main tasks on the team was to make the 3D Models for all the components of the airframe. I constructed these models with primarily G2 curvature continuity as it was the highest level that SolidWorks natively supports. Where possible, I used NURBS guide curves to achieve G3 continuity. The Wingtip was a particularly challenging area to model because it must blend a closed leading edge into an open trailing edge profile. Some images of this area can be seen on the left.

CAD Examples

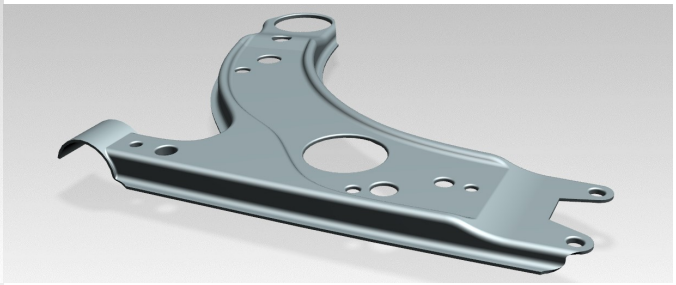


Formula 1 Wing Replica

Formula 1 has been a huge source of inspiration for me in my pursuit of engineering. One thing that has always fascinated me about the sport is the organic, yet functional shapes, that the aero devices often take on. For my first foray into surface modeling, I decided to take on replicating a pre-2019 rule change front wing.

Stamped Control Arm

During CAD training at Multimatic, I was taught how to model stamped components. As a self led exercise to hone my skills, I replicated a stamped control arm (VW group small car) in NX.



Suspension Shock Space Model

To design and validate suspension packaging, I created this model of the Fox Float X2 based on simplified OEM drawings supplemented with Vernier measurements.

Top Left and Right: My CAD Model

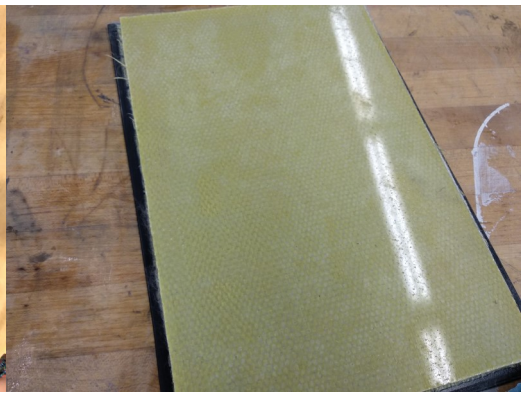
Bottom Left: Fox Float X2 Shock

Other Projects

Waterloo Formula Electric (2018-2019)

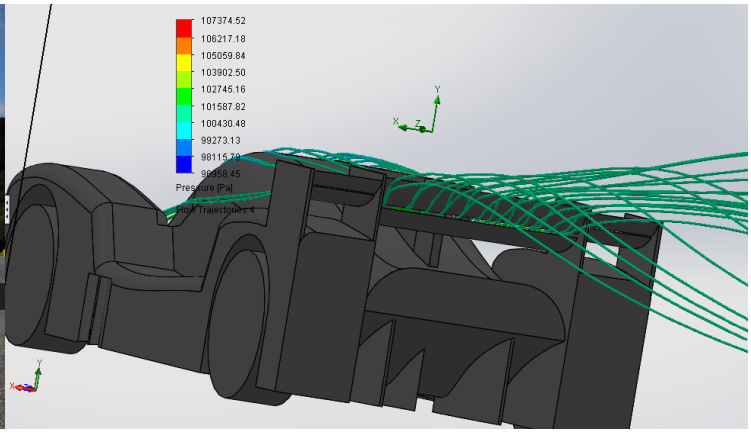
The Car

Front Wing Second Element

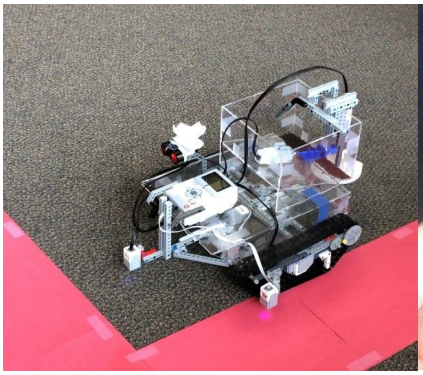


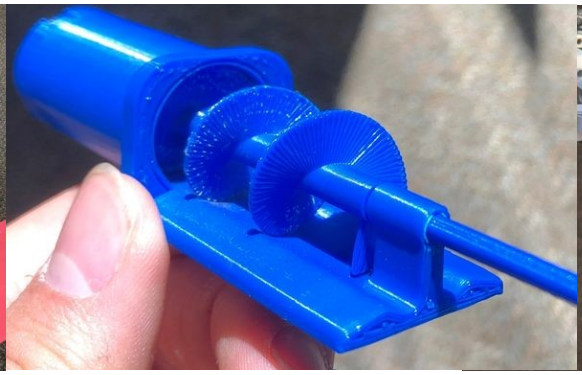
Driver Seatback Firewall

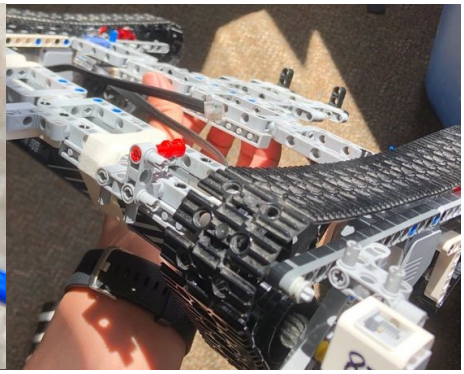
LMP1 Car Model (2015)



Autonomous Snowplough (2018)







Hobbies

Mountain biking, Skiing, snowboarding, flying, guitar, ultimate frisbee, basketball