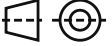
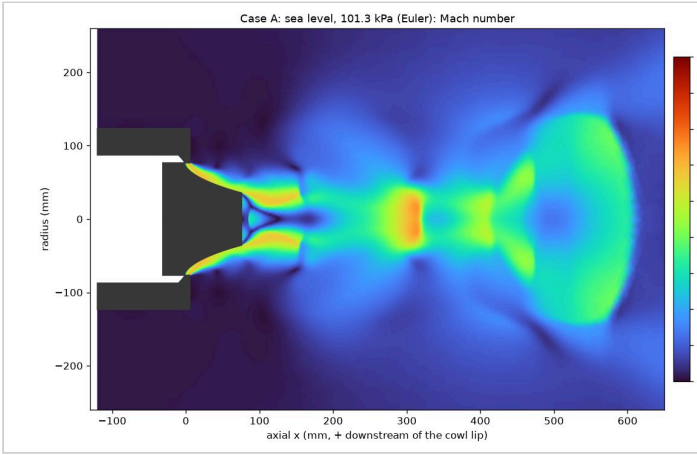
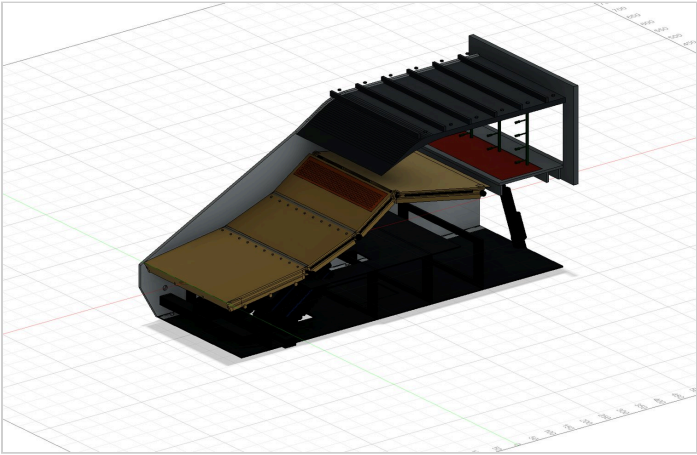
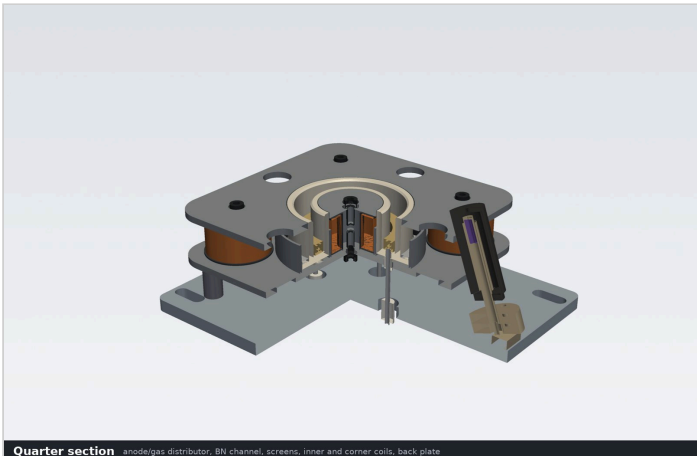
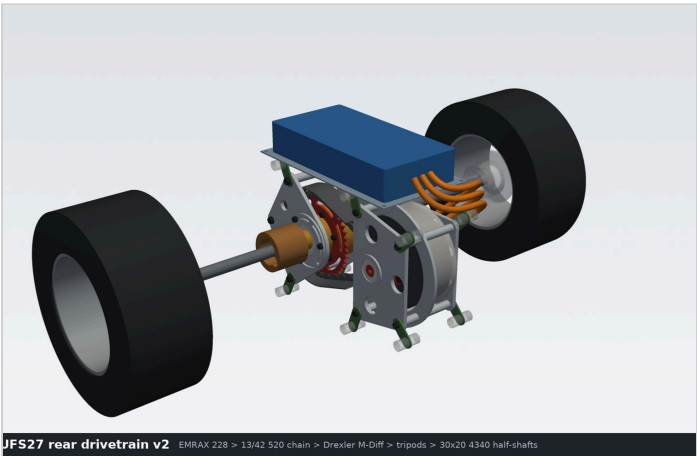


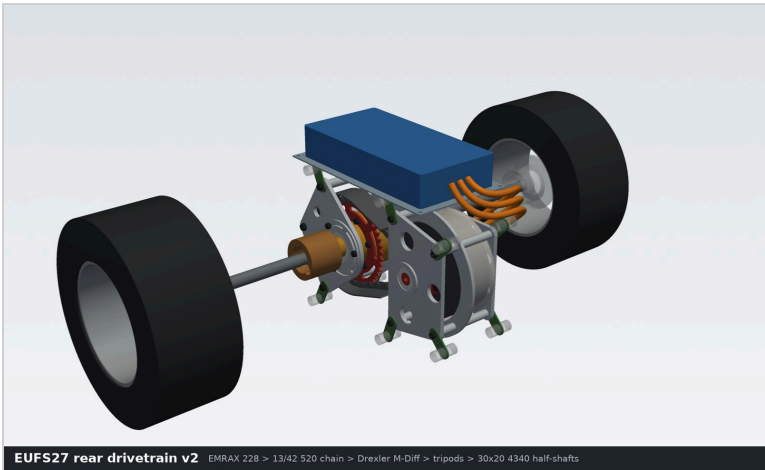
Matty Aldridge	DISCIPLINE MEng Mechanical Engineering	INSTITUTION University of Edinburgh
	FOCUS Aerospace design, simulation	LOCATION Edinburgh, UK
	CONTACT matty.aldridge07@gmail.com LinkedIn	
TITLE Engineering portfolio	REVISION B	SHEETS 6
 PROJECTION First angle		

I design aerospace and motorsport hardware: parametric CAD in SolidWorks, Fusion and Python, backed by stress, flow and thermal studies that I always check against a hand calculation.

These sheets cover six projects, including work for my university Formula Student team and rocketry society.

SHEET 1 Formula Student drivetrain	SHEET 2 Hall-effect thruster	SHEET 3 Supersonic intake
SHEET 4 Rocket hop vehicle	SHEET 5 Aerospike engine	SHEET 6 EV corner module





1.1 Rear drivetrain, rev B. EMRAX 228 motor, 13:42 chain reduction, limited-slip diff on eccentric carriers, half-shafts to the wheels. 75 components, clash-free.

A chain-drive rear powertrain package for the university team's 2027 electric car: motor cradle, outrigger bearing, eccentric diff carriers, sprocket and half-shafts, built as a full SolidWorks assembly.

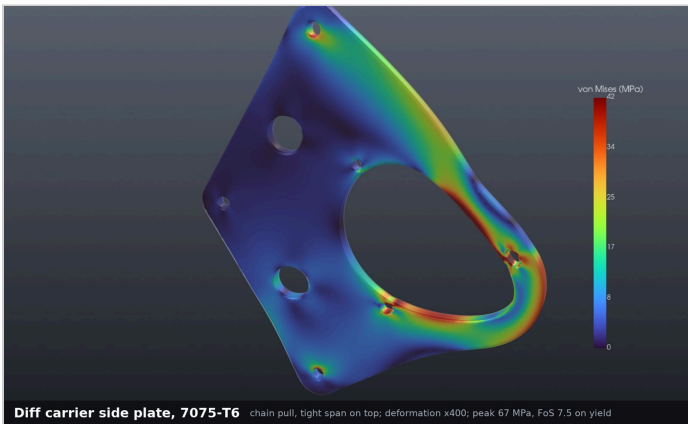
DATA

Reduction	13:42 (3.23)
Diff torque, design	1,066 N·m (×1.5 shock)
Chain pull, design	9.95 kN
Half-shaft	30 × 20 mm 4340 tube
Half-shaft FoS	1.98 static · 1.71 fatigue
Diff plate FoS on yield	7.5

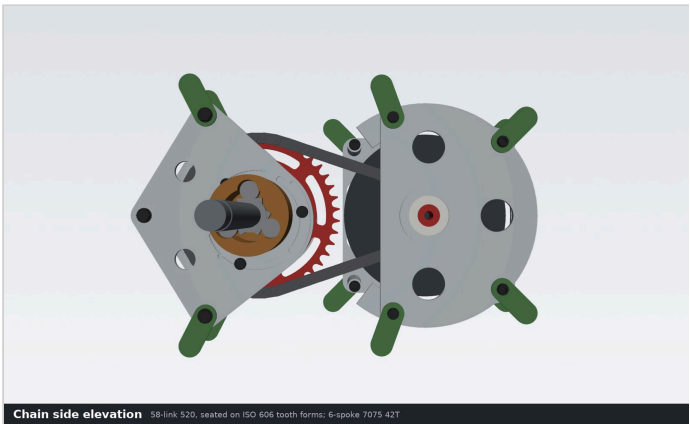
Every mount passes. The 42-tooth sprocket's window corners set the limit, at a yield FoS of 1.32 after rev B, so the next step is a thicker or solid web. This is a concept for my subteam, not the final car.

WHAT I DID

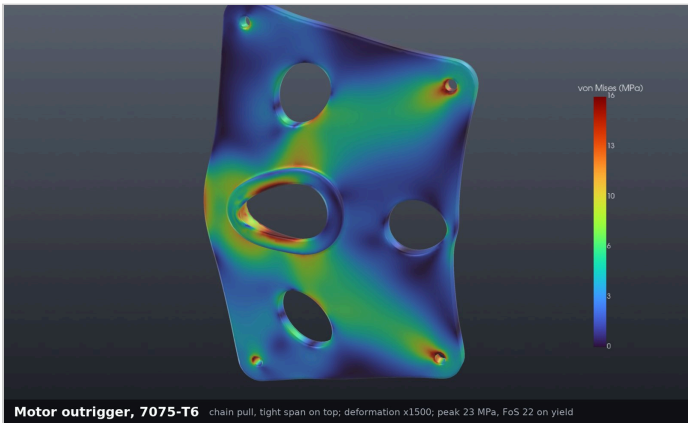
- Mechanical powertrain engineer on Edinburgh University Formula Student (EUFS).
- Packaged the motor cradle, outrigger, eccentric diff carriers, sprocket and half-shafts as a native SolidWorks 2026 assembly around the team's chosen motor, diff and inverter.
- Hand calcs for shafts, splines, bolts and bearings; CalculiX FEA of the plates and sprocket.



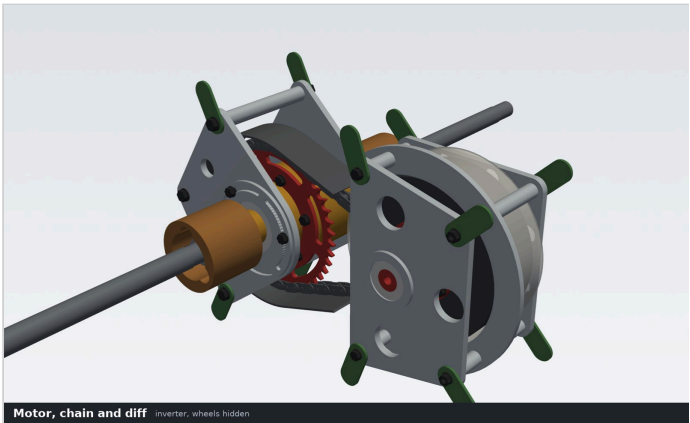
1.2 Diff carrier side plate under chain pull (CalculiX, 7075-T6). Peak 67 MPa, FoS 7.5 on yield; deformation ×400.



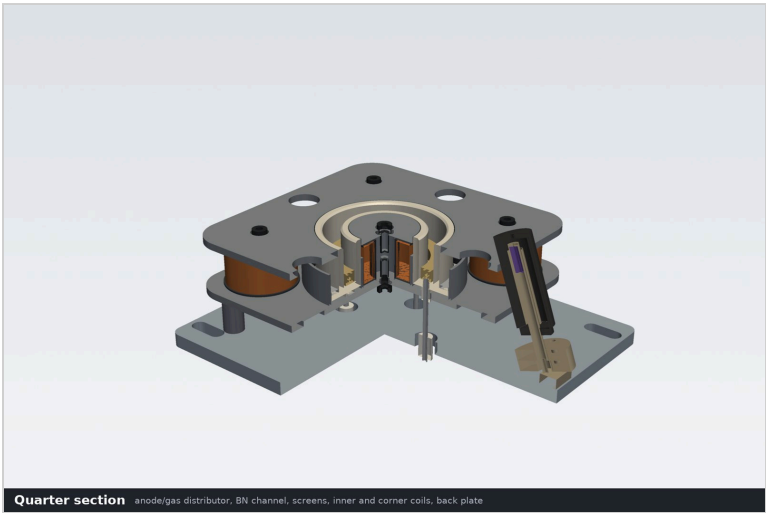
1.3 Chain side. 520 chain seated on ISO 606 tooth forms around the 6-spoke 7075 sprocket.



1.4 Motor outrigger, same load case: peak 23 MPa, so it has mass to lose.



1.5 Motor, chain and diff, wheels hidden.



2.1 Quarter section. BN discharge channel, stainless anode and gas distributor, Armco iron poles and coils, cathode tilted 20°.

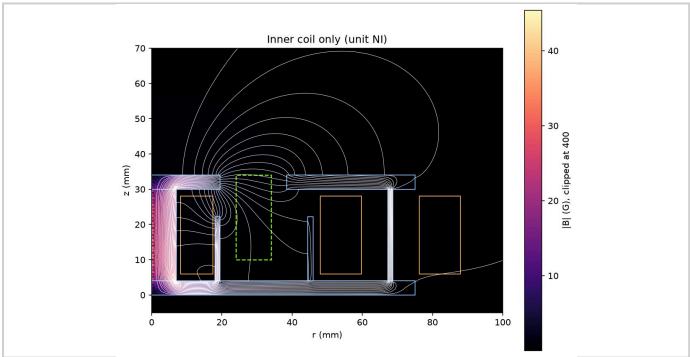
A Hall thruster for Project Xenith, the Edinburgh University rocketry society's plan to fire a student-built thruster at Race 2 Space. Boron nitride channel, iron magnetic circuit with five coils, heaterless hollow cathode.

Power	700 W
Propellant	Krypton
Channel	OD 68 / ID 48 mm
Peak radial field	200 G
Field model vs analytic	-0.13 %
Anode temperature, est.	~665 °C

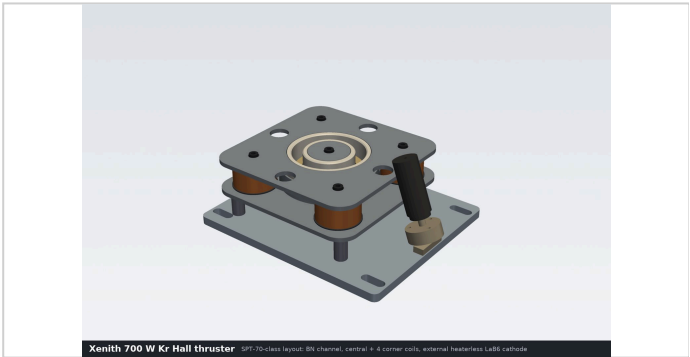
The thermal network puts the inner coil at about 400 °C, well past polyimide-insulated wire, so it needs ceramic-insulated wire. Hardware tests come next: cold flow, field mapping and the cathode.

WHAT I DID

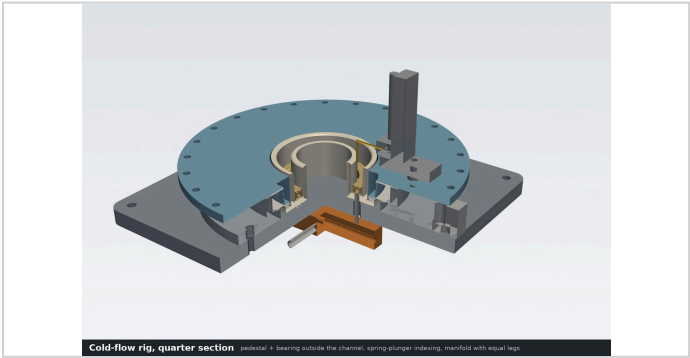
- Thermal-mechanical engineer on Project Xenith, a 13-student team in Endeavour.
- Sized the thruster from SPT scaling laws and modelled it in SolidWorks with a full bill of materials.
- Wrote an axisymmetric magnetics FEM, checked against an analytic solenoid, and a radiation and conduction thermal network.
- Designed the cold-flow test rig.



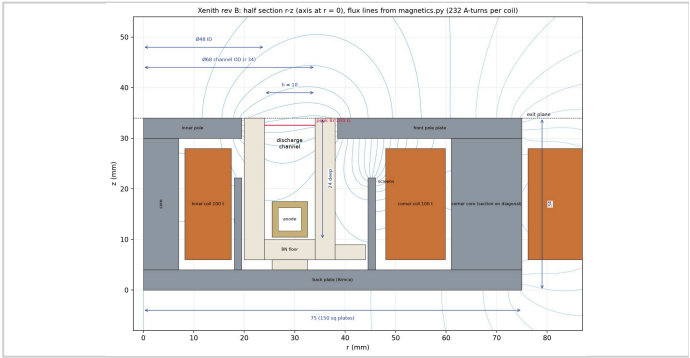
2.2 Magnetic field, inner coil only. Own axisymmetric FEM: flux lines over field strength, used to place the 200 G peak just inside the exit.



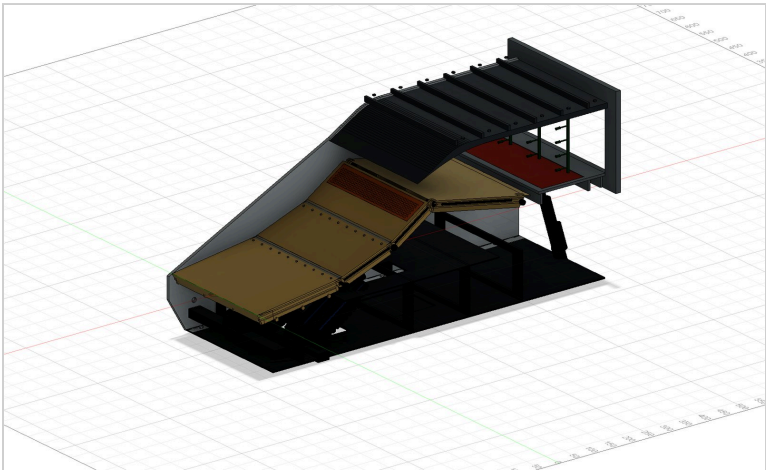
2.3 Thruster assembly. Square iron back plate, four corner cores, cathode on its bracket.



2.4 Cold-flow test rig, quarter section. Checks the anode's gas distribution with nitrogen before any plasma test.



2.5 Half section with flux lines and key dimensions, from the magnetics model.



3.1 Mach 3 configuration, sidewall removed. Two variable ramps on ganged ballscrews, bleed plate behind the third ramp, aft ramp on a roller track.

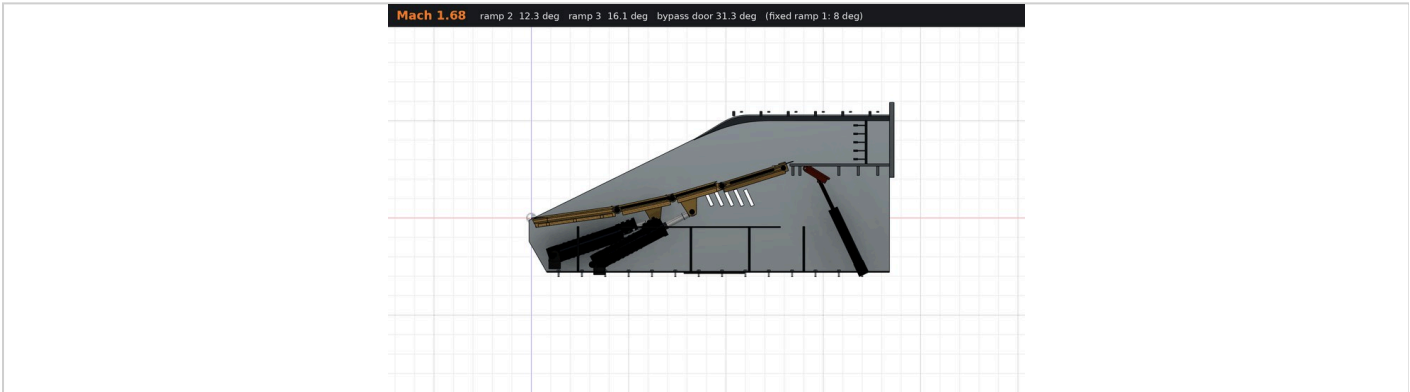
An air intake that changes shape across its speed range so the engine always gets slowed, high-pressure air.

Capture area	200 × 300 mm
Ramps	3 (2 variable)
Pressure recovery, Mach 3	0.833 (MIL spec 0.809)
Actuator surge load	12.9 kN
Ramp 3 stress, p99	136 MPa

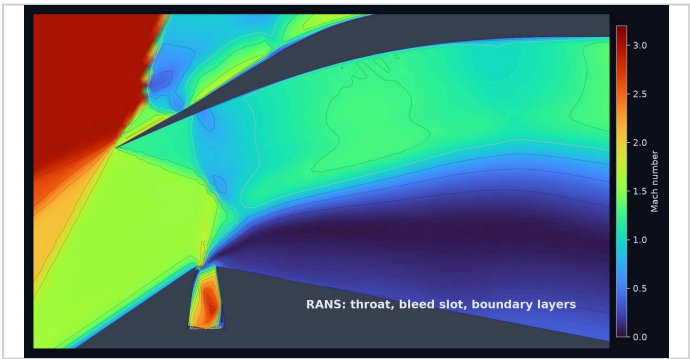
Meets the spec at Mach 3. At Mach 2.0 and 2.4 it falls short because the cowl lip is fixed; a moving lip is the next step.

WHAT I DID

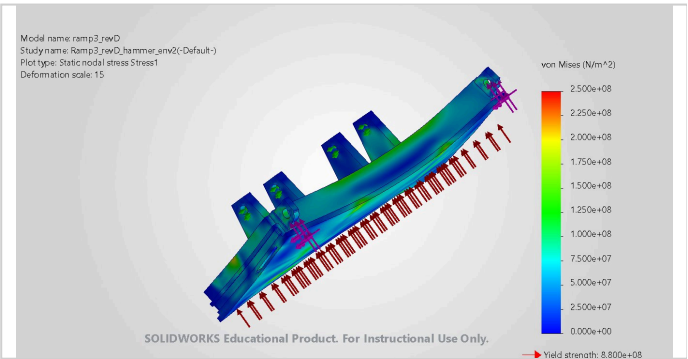
- Set the requirements: Mach 1.6–3.0, moving ramps on ballscrews, seals, bleed plate and bypass door.
- Worked out the shock schedule, which pushed the design from two ramps to three.
- Built the CAD and Fusion assembly, clash-checked at every ramp position.
- Ran SU2 CFD across the range after validating it on the Sajben case; ramp FEA and actuator hand calcs.



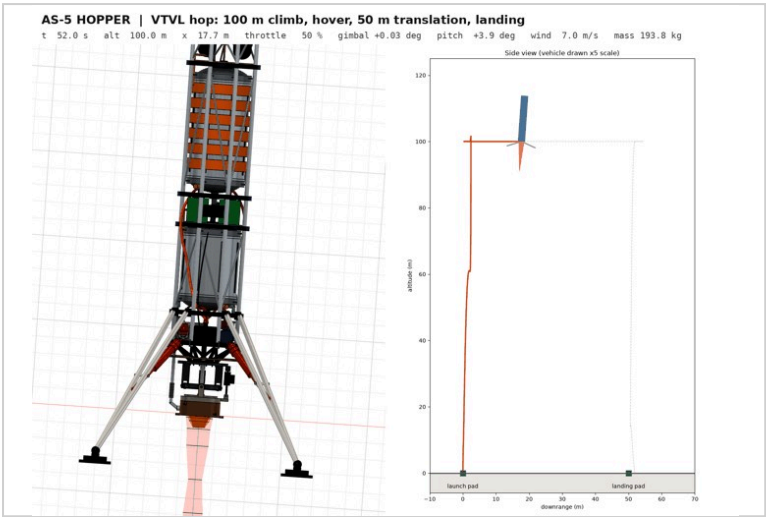
3.3 Ramp schedule, Mach 1.6 to 3.0, clash-checked at every frame.



3.4 Throat, viscous model. The bleed slot runs as a supersonic jet; a separation bubble forms behind the throat.



3.5 Ramp 3 under an engine surge. 1.8 mm peak deflection, drawn 15× true size.



A vertical take-off and landing test vehicle built around the aerospike on Sheet 5.

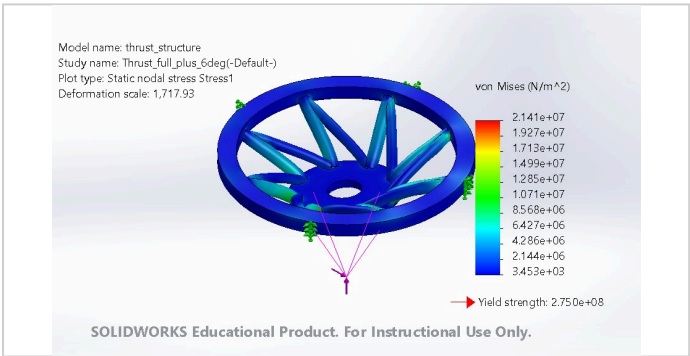
Take-off mass	242 kg
Thrust to weight	1.62
Hop apogee	101.6 m
Landing error	2.0 m
Parts in Fusion	45

Every structure passes with margin. The oxygen pump gets only 1.34× the suction head it needs, so it needs an inducer.

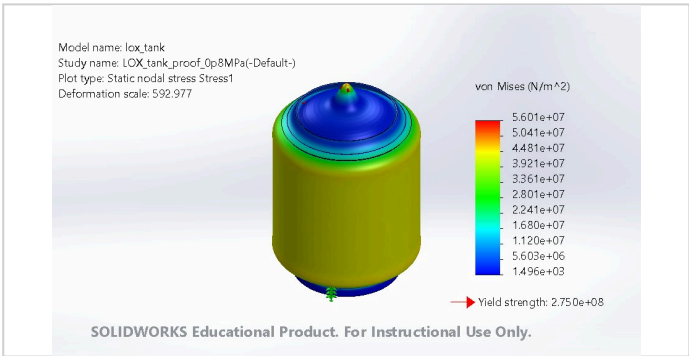
4.1 Simulated flight. Climb to 100 m, hover, move 50 m sideways through a gusting crosswind, land. Every number on screen comes from the flight-sim log.

WHAT I DID

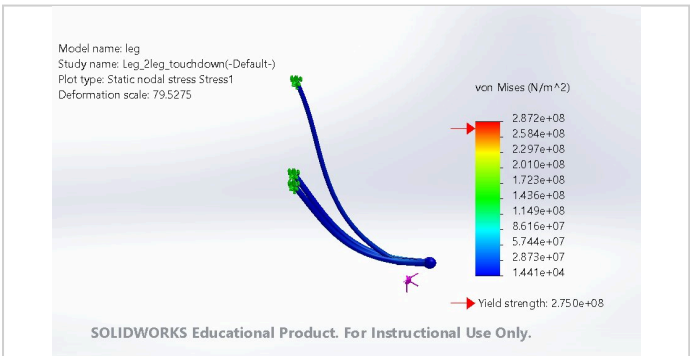
- Chose the concept: a hop vehicle with electric pumps, built around the Sheet 5 aerospike.
- Sized it and built a 45-part Fusion assembly, checked in SolidWorks.
- Wrote a 3-DOF flight sim with attitude control.
- FEA of the thrust structure, tank and legs; crosswind and feed-line CFD.



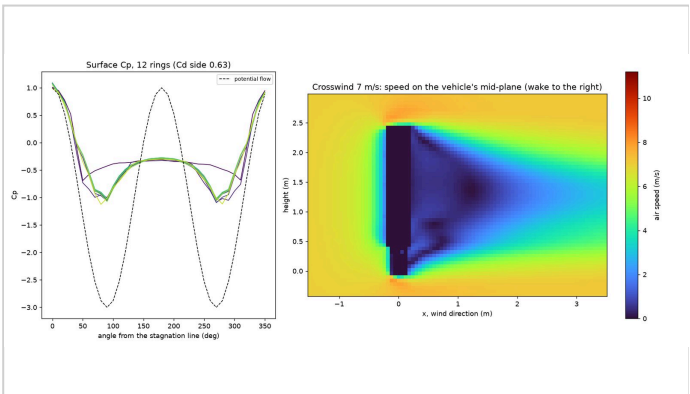
4.2 Thrust structure at full thrust, 6° gimbal: 21.4 MPa, FoS 12.8.



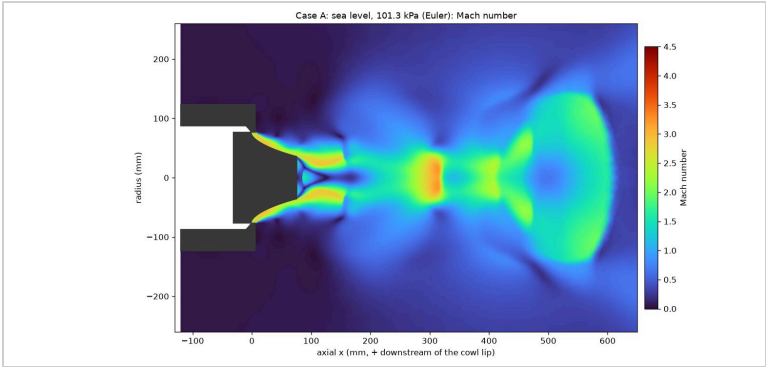
4.3 Oxygen tank at proof: 56 MPa against a 45 MPa hand calc.



4.4 Landing leg, two-leg touchdown with side load: tubes under 60 MPa.



4.5 Crosswind at 7 m/s (SolidWorks Flow): 19.5 N·m of upsetting moment against 273 N·m of gimbal authority.



5.1 Exhaust plume at sea level. The flow re-compresses onto the truncated spike, which is how an aerospike adapts to altitude.

An annular aerospike on a gimbal that steers it 6° in any direction.

DATA

Thrust, sea level	3.83 kN
Thrust, altitude	5.0 kN
Gimbal FoS	3.4
First mode	66 Hz

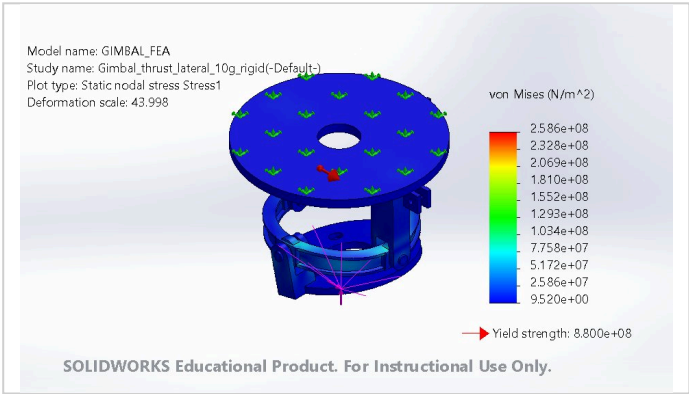
Structurally sound, thermally not. Regen cooling can carry 0.46 MW against 0.9 MW in, so the cooling concept has to change.

WHAT I DID

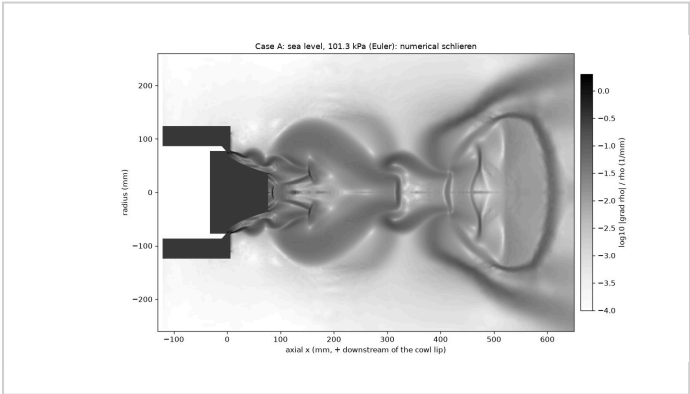
- Designed a 5 kN annular aerospike with regenerative cooling on a two-ring gimbal.
- Gimbal kinematics and actuator sizing.
- Plume CFD checked against Angelino's method; gimbal FEA and modal analysis; a cooling-channel optimiser.



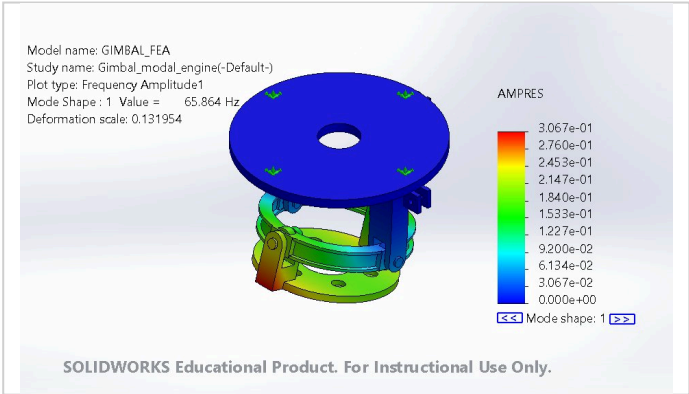
5.2 Gimbal sweep. The full 6° cone without clashing; stroke and force from the kinematic model.



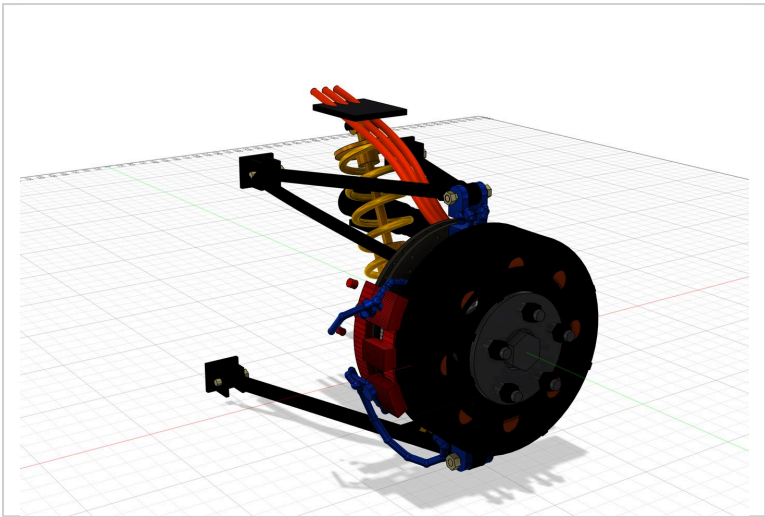
5.3 Gimbal at 10 g sideways. Strong enough, but 0.82 mm deflection against a 0.5 mm limit.



5.4 Shock cells behind the spike base (simulated schlieren). Wall pressures match Angelino's design method.



5.5 First mode, 66 Hz. The engine rocks on the gimbal rings.



6.1 Corner assembly. Wishbones, coilover, ventilated disc, caliper, hub, coolant and high-voltage lines.

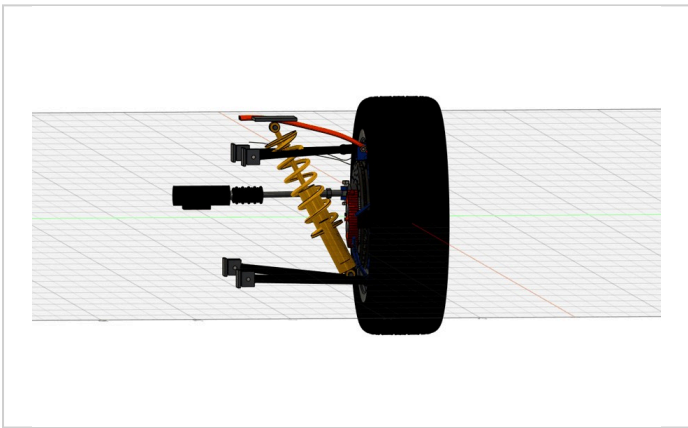
A lightweight steering knuckle and in-wheel motor mount, shaped by topology optimisation.

DATA	
Knuckle mass	2.13 kg
Bearing L10 life	8,690 h
Bump steer	< 0.1°
Bearing seat	49–64 °C

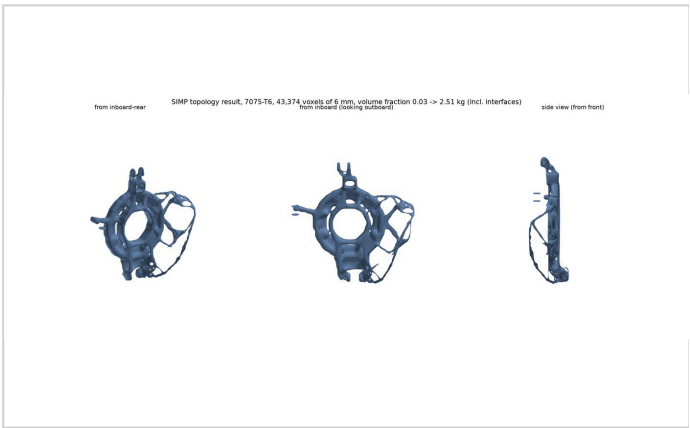
Geometry and kinematics are done. The final stress check is paused after the mesher failed on the organic shape.

WHAT I DID

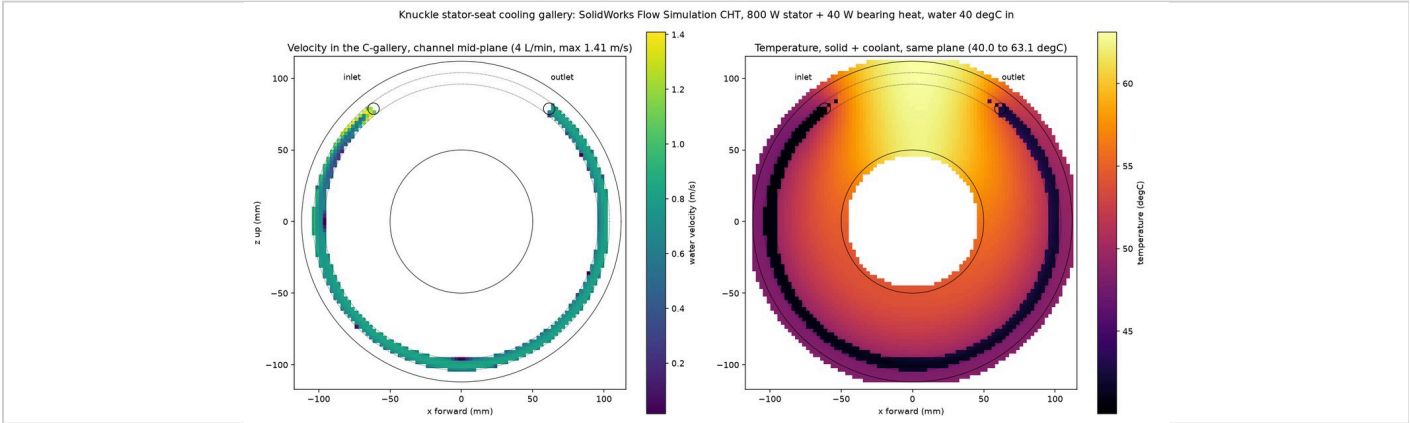
- Sized the knuckle and motor mount from load cases; checked bearing life and kinematics.
- Wrote a 6-DOF suspension kinematics solver and a 3-D topology optimiser, then rebuilt the knuckle as CAD.
- Built the 33-part Fusion corner assembly and modelled heat transfer in the coolant gallery.



6.2 Bump and rebound. Every frame is posed by the kinematic solver, not keyframed.



6.3 Topology optimisation, then rebuilt as CAD from checked members around the bearing, ball joints and steering arm.



6.4 Motor-seat cooling (SolidWorks Flow, conjugate heat transfer): 800 W of stator heat keeps the seat between 40 and 63 °C.