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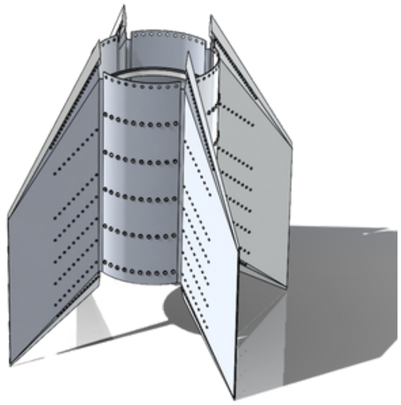
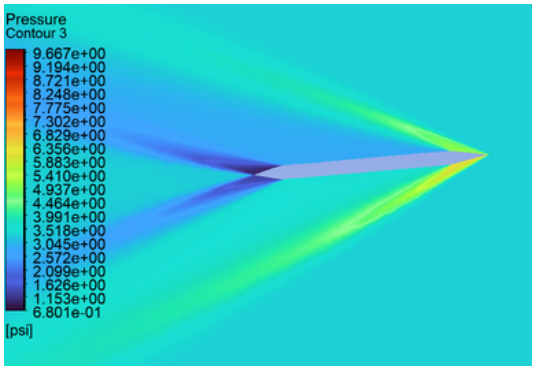
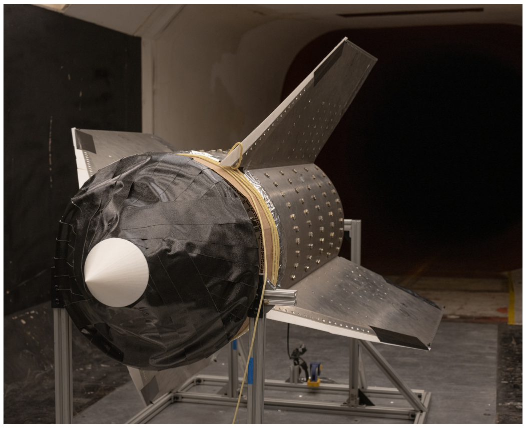
ROCKET FINS - MASA







What?

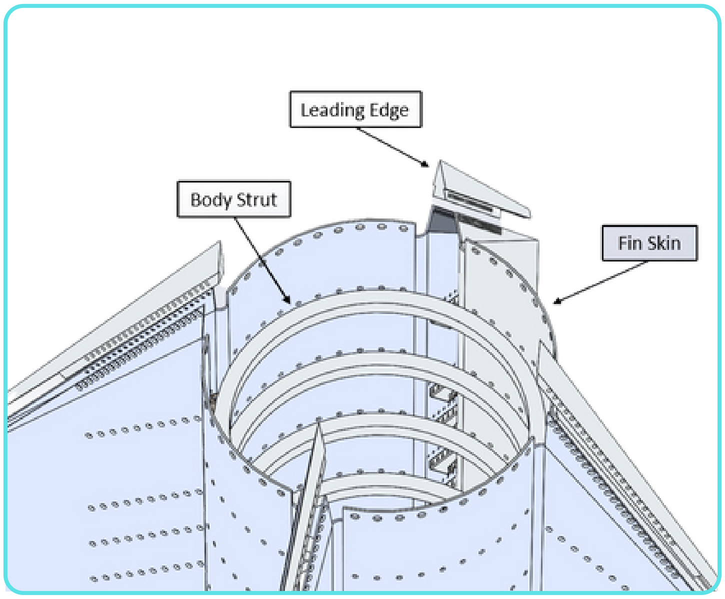
- Led the **design** and rapid **prototyping** of a supersonic (Mach 4) capable rocket fin assembly
- Must withstand **950 lbs** of force in cantilever
- Needs to be **4-ft tall** and **3-ft wide** to ensure rocket stability

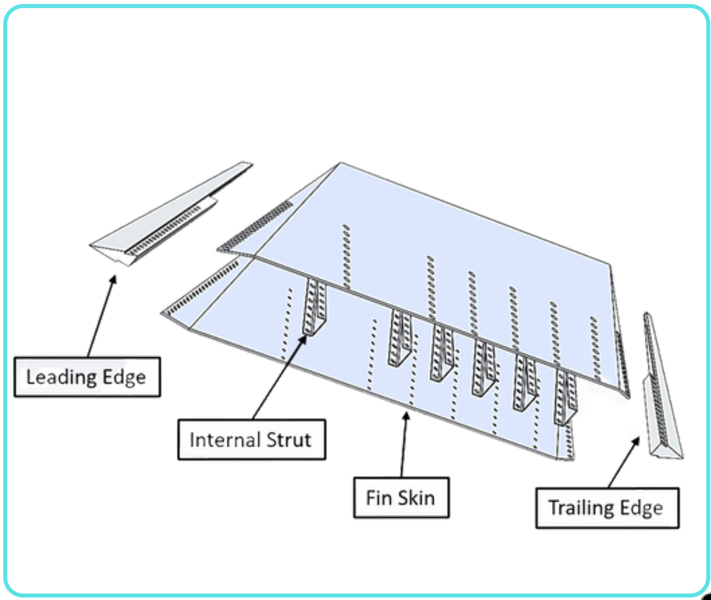
How?

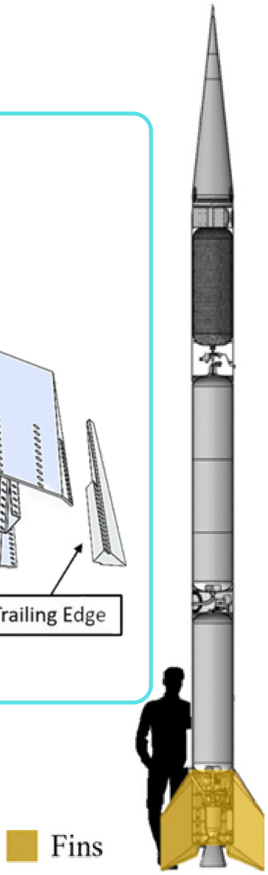
- Used sheet metal/surface features in **SolidWorks** for design
- Optimized aero-thermal with **ANSYS Fluent**
- Optimized aero-structure using **ANSYS Static/Transient Structural**
- Utilized in-house manufacturing **(CNC Mill, sheet metal bender)** for rapid prototyping

Results

- Completed assembly in 2 months
- Achieved a **thermal-structural SF** of **2**
- Obtained aerodynamic data through full scale **wind tunnel** testing
- Optimized design cycle, decreased time by **70%**







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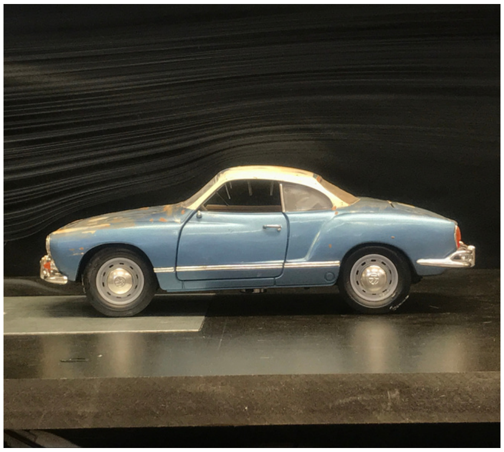
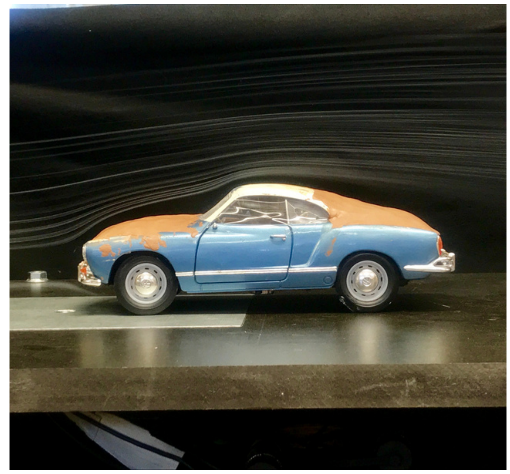
EXPERIMENTAL VEHICLE AERODYNAMIC - TU BERLIN





What?

- Analyze aerodynamic characteristics of a scaled down 1962 Volkswagen Karmann Ghia using an open-return **wind tunnel**
- Modify the model based on test data to decrease drag coefficient

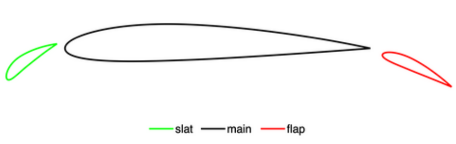
How?

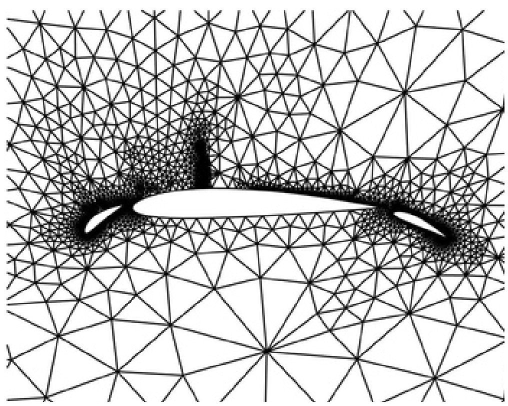
- Utilized clay for rapid shape modification
- Used **pressure taps**, **force scale** and **wake measurement** methods to quantify vehicle lift and drag

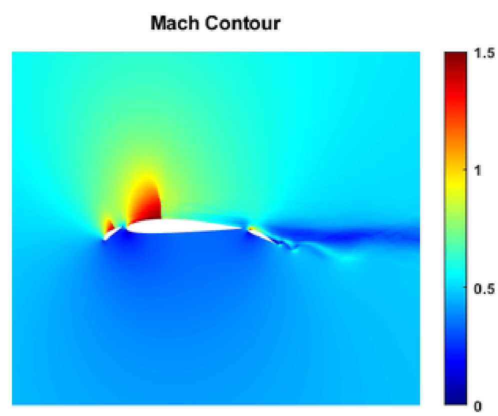
Results

- Delayed flow separation, confirmed via smoke visualization
- Decreased drag coefficient from 0.57 to 0.43; a total of **25%**

CUSTOM CFD SOLVER - AEROSP 623 CFD II







What?

- Implemented from the ground up a **finite volume solver** capable of solving the inviscid Navier-Stokes equation

How?

- Employed a combination of **MATLAB** and **C++**
- Read various literature to expand solver capabilities

Results

- Successfully implemented solver
- Added **adaptive meshing** capabilities
- Added **Discontinuous Galerkin (DG)** Finite Element Method
- Varied solver order to achieve **shock capturing**

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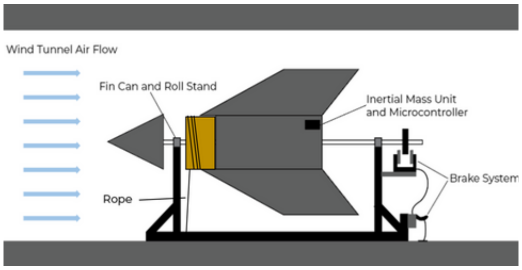
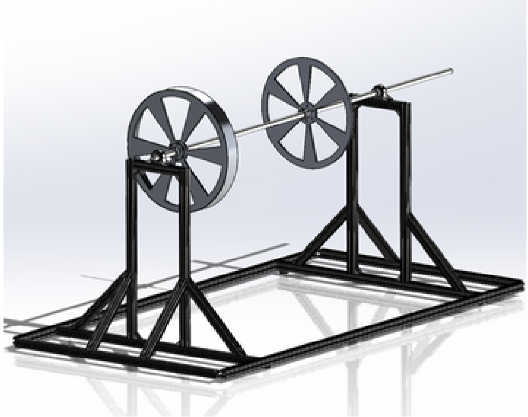
WIND TUNNEL/STATIC TEST FIXTURE - MASA





What?

- Analyze the rotational torque induced by aerodynamic forces in the **wind tunnel**
- Constrains translation but allows rotation about its central axis
- Must be able to be converted into a **static test stand**
- Must withstand a windspeed of **180 mph**

How?

- Used **Solidworks** for design
- Employed **Intertial Mass Unit** (IMU) for rotational measurement
- Used **dial indicator** for static deformation measurement
- Post-processed data in **MATLAB**

Results

- Quantified angular acceleration as a function of airspeed
- Validated FEA simulations with an error margin **below 20%** (partially)
- Approximated their relationship as a **second order ODE**
- Visualized aerodynamic flow during rotation via smoke screen