Hirsh Kabaria

hkabaria@umich.edu | (813) 766-2335 | linkedin.com/in/hirsh-kabaria | US Citizen

EDUCATION

University of Michigan **May 2024**
Aerospace Engineering, Bachelor of Science in Engineering Ann Arbor, MI
Computer Science, Minor
3.6 / 4.0 GPA
Notable Classes: Dynamics and Vibrations, Aerodynamics, MATLAB Applications for Engineers, Aerospace Structures and Solid Mech
Honors and Memberships: ΣΓΤ Honor Society (Fundraising Lead ’22-’23, Initiated Dec ’21), Dean’s List (Winter ’20), AIAA (Since ’20)

SKILLS

Engineering Administration: Project Management, Business and Government Relations, Team Leadership, Systems Engineering
Engineering: Finite Element Analysis (Ansys Mechanical), CAD (SolidWorks & NX w/ Teamcenter), MATLAB
Manufacturing: Manual Lathe, Composite Layup, Waterjet, Metal and CO2 Laser Cutter
Computer: C++, Java, Ubuntu, Adobe CC (Lightroom Classic, Photoshop, Premiere, Illustrator), MS Office Master Certification

EXPERIENCE

Michigan Aerospace Communications, *Summer Assistant* **Summer 22**
University of Michigan Department of Aerospace Engineering Ann Arbor, MI
- Created a narrative to present the best of Michigan Aerospace to our followers and share our values with the world.
- Raised morale and built a community through graphics, giveaway merchandise, and social media.

Nosecone and Recovery, *Senior Engineer* **Fall 21, Winter 22, Summer 22**
Michigan Aeronautical Science Association (MASA) Rocket Team Ann Arbor, MI
- Coordinated requirements, deadlines, funding, and designs between the nosecone, recovery, and airframe teams to facilitate nosecone attachment and separation as part of our recovery sequence.
- Laid up multiple couplers and airframes, delivering flight components ahead of schedule despite redesign due to equipment failures.
- Conducted full system testing and integration with deployment, including redesign of pyrotechnic bolt.

Tank Pressure Control Vibration Testing, *Engineer* **Summer 2022**
Michigan Aeronautical Science Association (MASA) Rocket Team Ann Arbor, MI
- Designed mounting hardware for high pressure systems with a resonant frequency out of the test range.
- Aided in the assembly of pressure systems, data recording, and test setup.

Business Division, *Lead* **Summer 21, Fall 21, Winter 22**
Michigan Aeronautical Science Association (MASA) Rocket Team Ann Arbor, MI
- Led a team of 5 to manage over $100,000 in funding, design team merchandise, and oversee public relations.
- $28,000+ raised in NASA and UMich grants, corporate sponsorships, and crowdfunding.
- 600% growth of the team’s Twitter, Facebook, and LinkedIn pages through engaging visual content.
- Collaborated with NASA, airport, and local authorities to find a suitable liquid engine test site.
- Panelist at AIAA SciTech 2022 discussing student rocketry and the creation of the Academic Rocket Launch Alliance.

MACH 6, *FEA and Structures Engineer* **Winter 22**
MACH AIAA Design-Build-Fly Team Ann Arbor, MI
- Simulated loads on the wing box and motor mount and proposed a composite design for the motor mount to better survive given loads.
- Designed a one-step removable rear fairing for easy and quick access to the aircraft cargo bay during competition.

Fin Testing, *Project Lead* **Summer 21**
Michigan Aeronautical Science Association (MASA) Rocket Team Ann Arbor, MI
- Designed a rotating test stand for the fin can, allowing us to evaluate induced roll and fin loading in UM’s 150 mph 5’ x 7’ wind tunnel.
- Met with fin team, wind tunnel management, and senior MASA engineers to determine requirements and timelines for wind tunnel testing.

Separation Mechanism, *Engineer* **Winter 21, Summer 22**
Michigan Aeronautical Science Association (MASA) Rocket Team Ann Arbor, MI
- Conducted FEA and multiple redesigns to ensure survival given significant bending moment loads on the nosecone-airframe interface.
- Ran trade studies to find the best COTS parts to ensure successful separation in an abort case.

Hirsh Kabaria
ENGINEERING PORTFOLIO

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INTRODUCTION

I am a junior studying Aerospace Engineering at the University of Michigan with a minor in Computer Science. During my time here, I have designed, built, and tested record breaking rockets with MASA, as well as innovating new aircraft mechanisms with MACH. I have significant experience in team leadership, project management, and the design of deployment systems and structural components for flight vehicles.

Please see my attached resume for more details!

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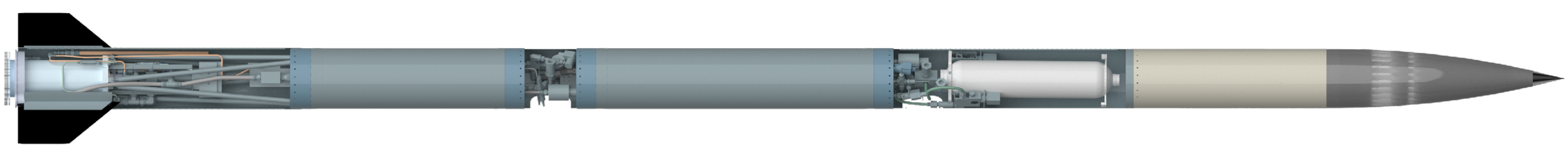
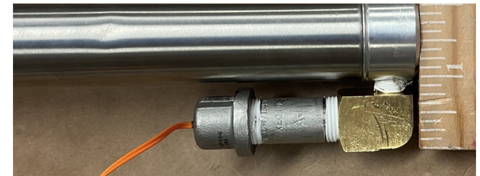
A render of Clementine, MASA's current rocket, planned to launch to record-breaking heights in November 2022.



Clementine

Nosecone-Airframe Coupler (2021-2022)

Since August 2021, MASA has been working Clementine, a 1.5 year project to bring us back to the launchpad while innovating on the best of previous designs. Clementine will double the current altitude record when it launches later this year, and will be one of the most advanced rockets ever built at the collegiate level.



I am leading the design, testing, and construction of the nosecone-airframe coupler, ensuring the nosecone stays attached up until parachute deployment. During the design phase, I acted as a liaison between the nosecone, recovery, and airframe teams, coordinating timelines, writing grants, and ensuring interoperability and ease of assembly.

During the summer of 2022, we took the coupler into the prototyping and testing phases. I led multiple layups, of both the coupler and the airframe. These prototypes were tested exhaustively, ensuring the shear pins would break on deployment, and that the nosecone would clear the airframe in flight. When our testing showed that the pyrotechnic bolt design was unreliable, I designed and sourced a new system, improving reliability and ease of assembly.

In the coming months, we plan to make a smoother coupler for flight, as well as start nosecone integration and full system testing!

Tangerine Space Machine

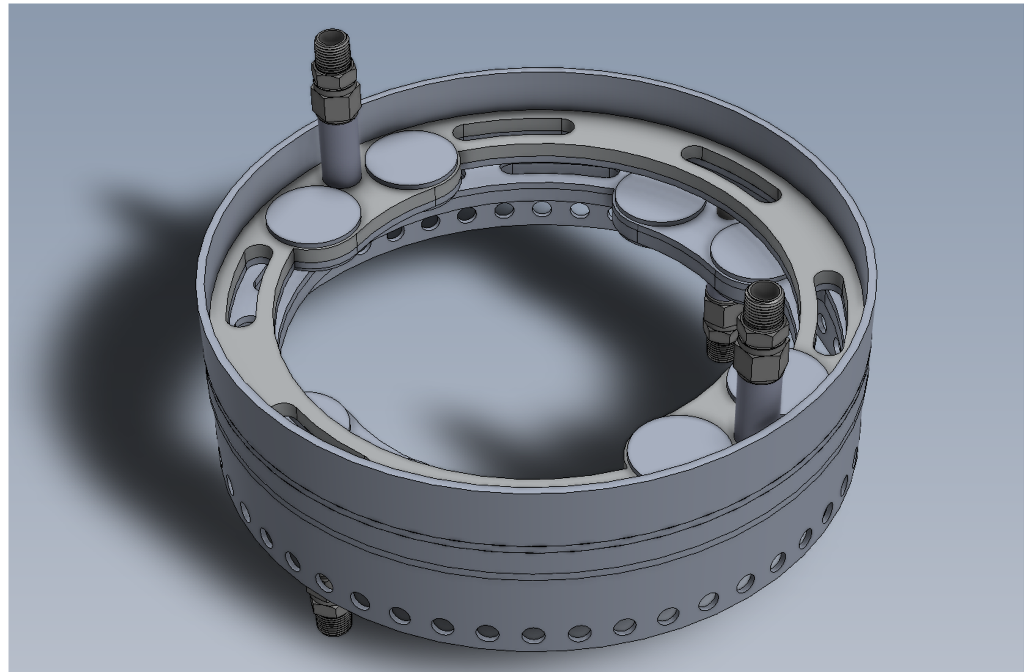
Separation Mechanism (2020-2021)

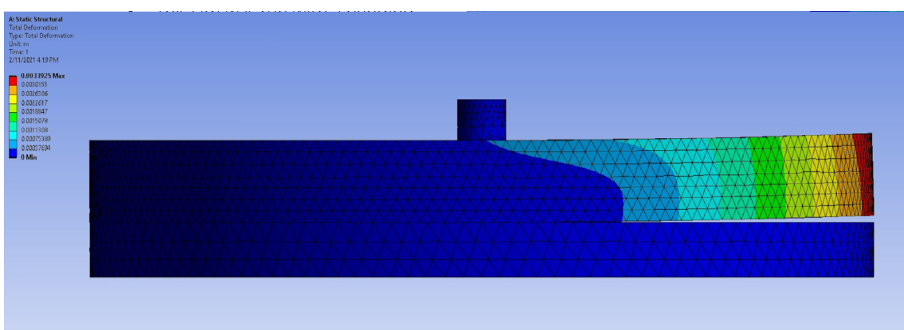
As part of the Base 11 Space Challenge, Tangerine Space Machine was set to be the first student built liquid rocket to cross the Kármán line and enter space. As such, the separation mechanism faced a completely different set of design requirements.

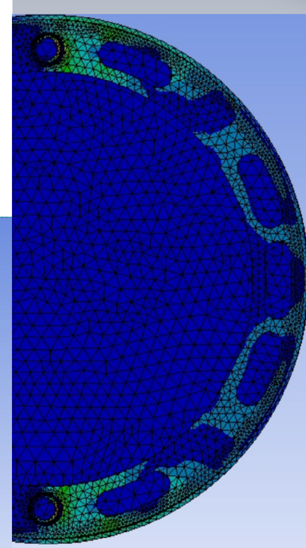
Our two largest considerations were the oxygen-free environment and the bending moment induced by aerodynamic loads.

In regards to the environment, we had a redundant system of two pins, with two rings pushed apart by a set of 8 springs. It was important that we maximized spring energy to ensure recovery and range safety in an abort case, and as such, I conducted a trade study out of 543 springs to find which held the most energy within our size and clamp force.

However, our greatest challenge was the bending moment induced by the nosecone. I proposed and simulated multiple designs in ANSYS Mechanical, resolving issues with yielding and failed simulations. Eventually, we settled on a thicker base and walls, with holes to save mass.







Tangerine Space Machine

Fin Can Test Stand (Summer 2021)

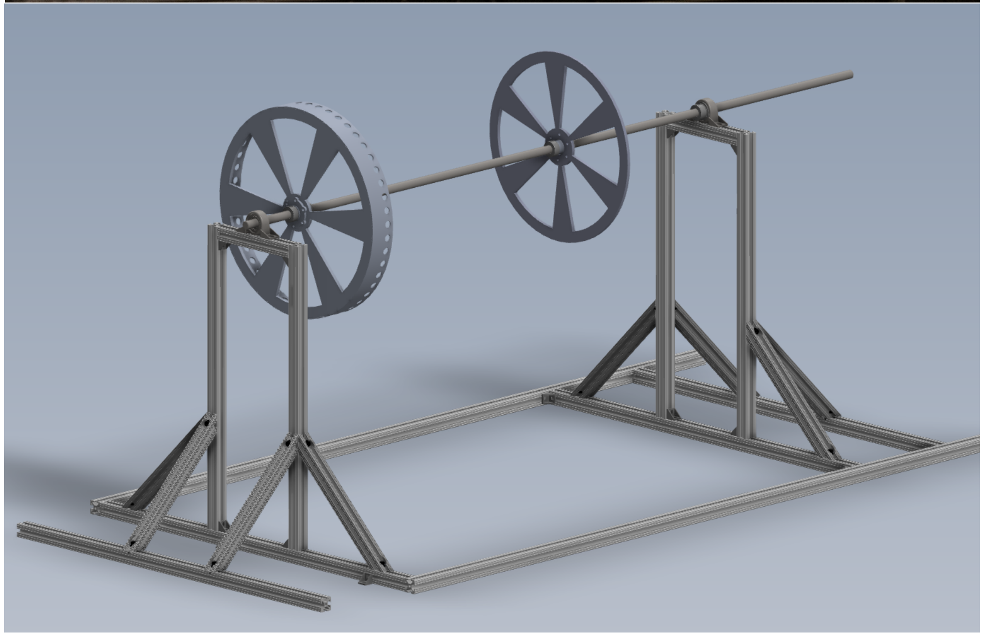
A common issue with fins in rocketry is that any inaccuracies in construction might cause them to induce significant roll. Given that partner teams have lost rockets due to inertial roll coupling, this was of great concern to the team.

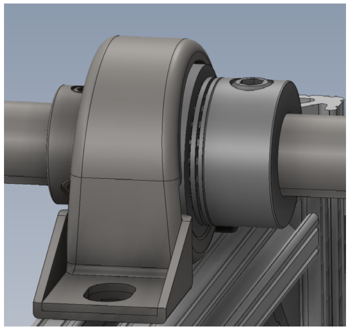
Over the summer of 2021, I designed a rotating stand that allowed us to quantify this effect, in the university's 5'x7' wind tunnel. It had to:

- Be adaptable to the pre-existing floor hole layout
- Adjust to up to 2° AOA
- Survive 400 lbs of downforce and ~100 lbs of thrust
- Not significantly disrupt the airflow around the fins

As such, I chose 80/20 extrusion due to its adaptability. I then drafted designs in SolidWorks and performed an internal design review before moving into discussions with the wind tunnel manager. From there, I significantly reinforced the design and moved into the production phase.

I also wrote the grant that funded the project and sourced the materials from metal suppliers and McMaster-Carr. As the summer ended, the project was handed off to a capstone project team.





I used a needle-roller thrust bearing to ensure drag forces were transferred around the bearing.

MACH 6

FEA and Rear Faring Hatch

I discovered MACH in the December 2021, and joined soon after, wanting to explore my interest in aircraft. At the time, MACH did not have anyone with FEA experience, and as such, my role was to simulate loads on the wing spar attachment and motor mount.

The wing spar attachment was a custom 3-D printed geometry, and the simulations found that it had a sufficient safety factor, backed up by physical testing. For the motor mount, the preliminary design called for a wooden plate. However, the simulation showed that it would fail. We instead switched over to two plates, one plastic and one metal, bolted together.

The challenge called for us to insert two packages into the plane as quickly as possible. I led the development of a single pin design for our detachable rear fairing, decreasing complexity, while still constraining all six degrees of freedom. This allowed us to retain the aerodynamics of a smooth rear fairing, while maintaining easy access for the ground crew.

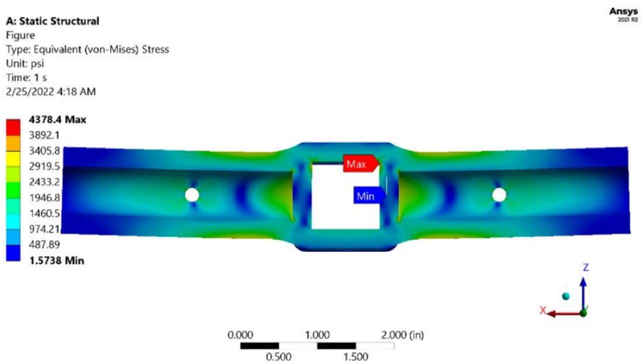


Figure 31: Stress in Wing Mount for 3-G Upward Load Case

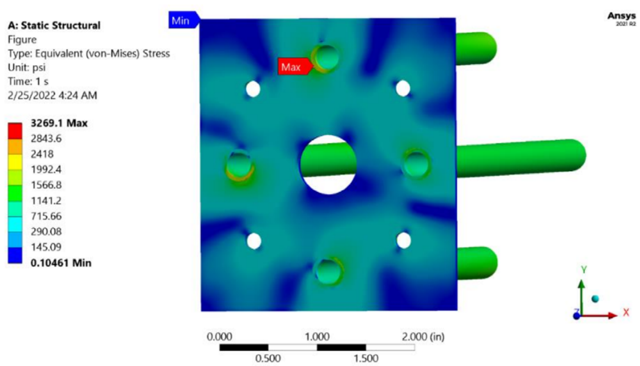


Figure 32: Stress Results from FEA Analysis of Motor Mount