Human Powered Vehicle

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Mid-Point Review

Overview

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- Current Project Status
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- Steering
  - Terminology
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Introduction

- There is a need for engineering efficient, reliable human powered vehicle in order for people to commute in rural and underdeveloped communities
- The goal is to reduce the carbon footprint of vehicles by designing safe, efficient, and reliable vehicle that can be powered by human input
- The objective is to design this vehicle using the given criteria by the ASME Human Powered Vehicle competition officials and win every competition possible
- Constraints include not being able to use vehicle from past years, and it must be able to function in the speed and endurance tests during the competition weekend
- The main criteria taken into account for the vehicle include the frame, steering, material, power input, fairing, and seating position

Competition Details

- Over 50 different schools have been registered for the HPV West Competition in San Jose, California

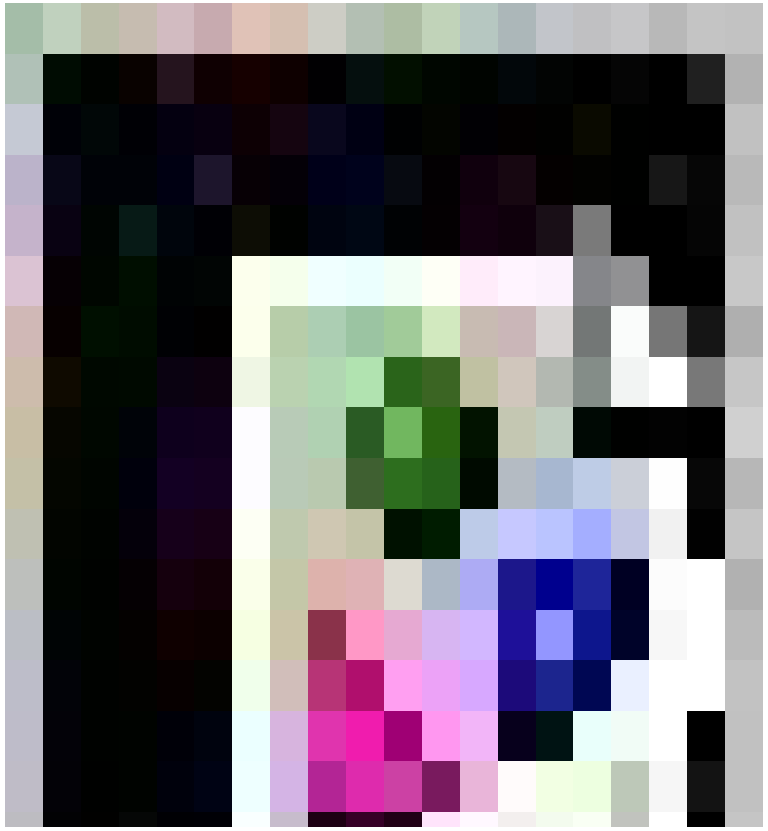
- All of the vehicles will be subjected to a number of tests that judges will use to determine the best vehicles
  - Safety, structure, design, analyses, innovation, aerodynamics, etc.

- Women’s and Men’s sprints/drag races

- 2.5 Hour endurance race with multiple team members

Current Project Status

Construction

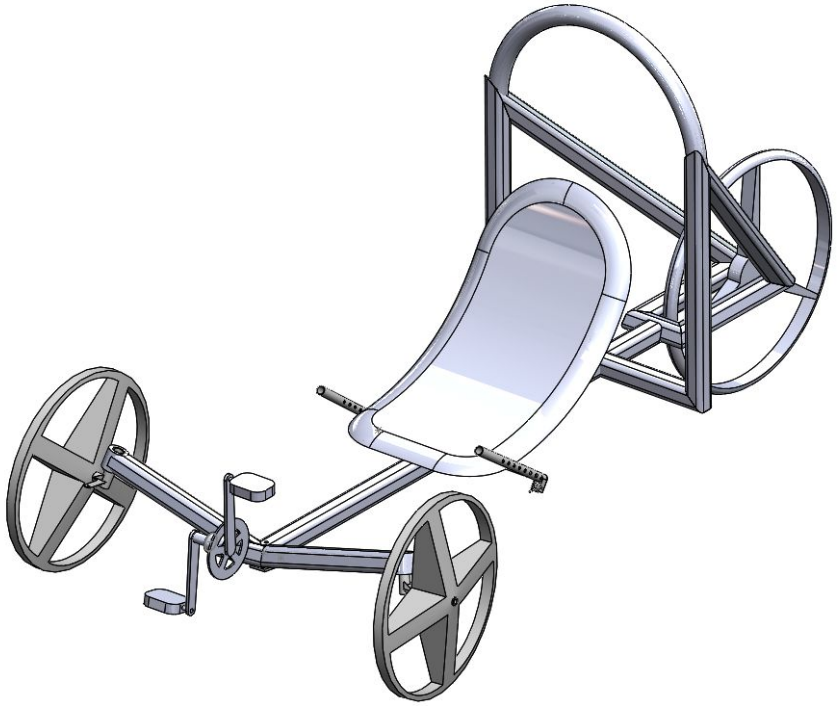


Budget

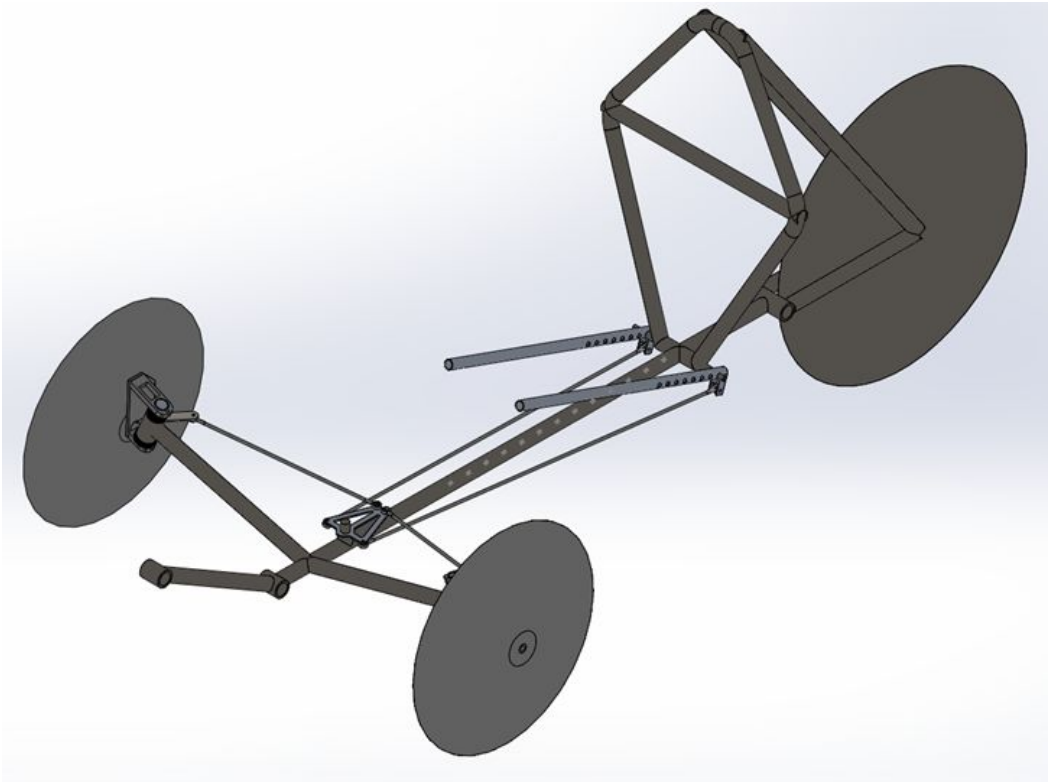
Description	Cost
Steel Plate, Aluminum Plate, Steel rod, Bearing, Adapter	$289.00
Derailer Hanger	$17.00
Heim Joints	$83.00
Lights	$68.00
Chromoly Steel	$300.00
Cranks, sprockets, caset, shifters, brake, chain	$1,010.00
Total	$1,767.00

Solidworks Models

Proposed design



Current design



Frame

- Material selection
  - Steel chosen over aluminum due to material properties & availability
- Testing
  - Ansys FEA simulation to simulate load testing
  - Physical load to failure testing
- Design considerations
  - Use of trusses to help distribute loads
  - Weight vs rigidity
- Manufactured to a great degree of precision
  - Crucial for keeping square and steering in line
  - Ensuring all bearings fit securely
- Problems that arose
  - Material deforming due to heat
  - Miscommunication with vendors

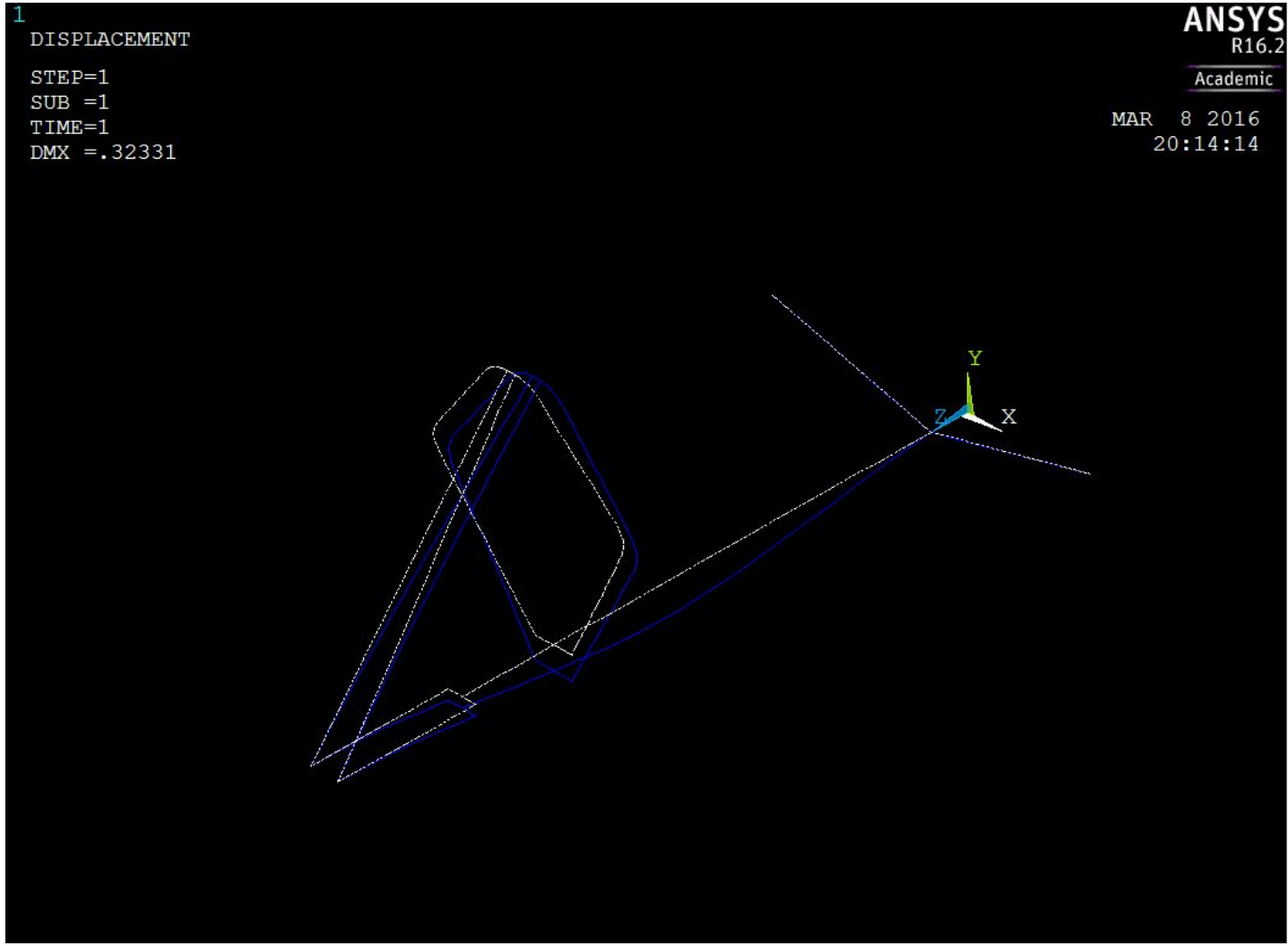
ANSYS Stress Analysis Frame

Assumptions:

- Modulus of elasticity = 29*(10)^6 N/m^2
- Tube outer diameter = 1.25 in.
- Wall thickness = 0.083 in
- Applied force = 400 lbs

Results:

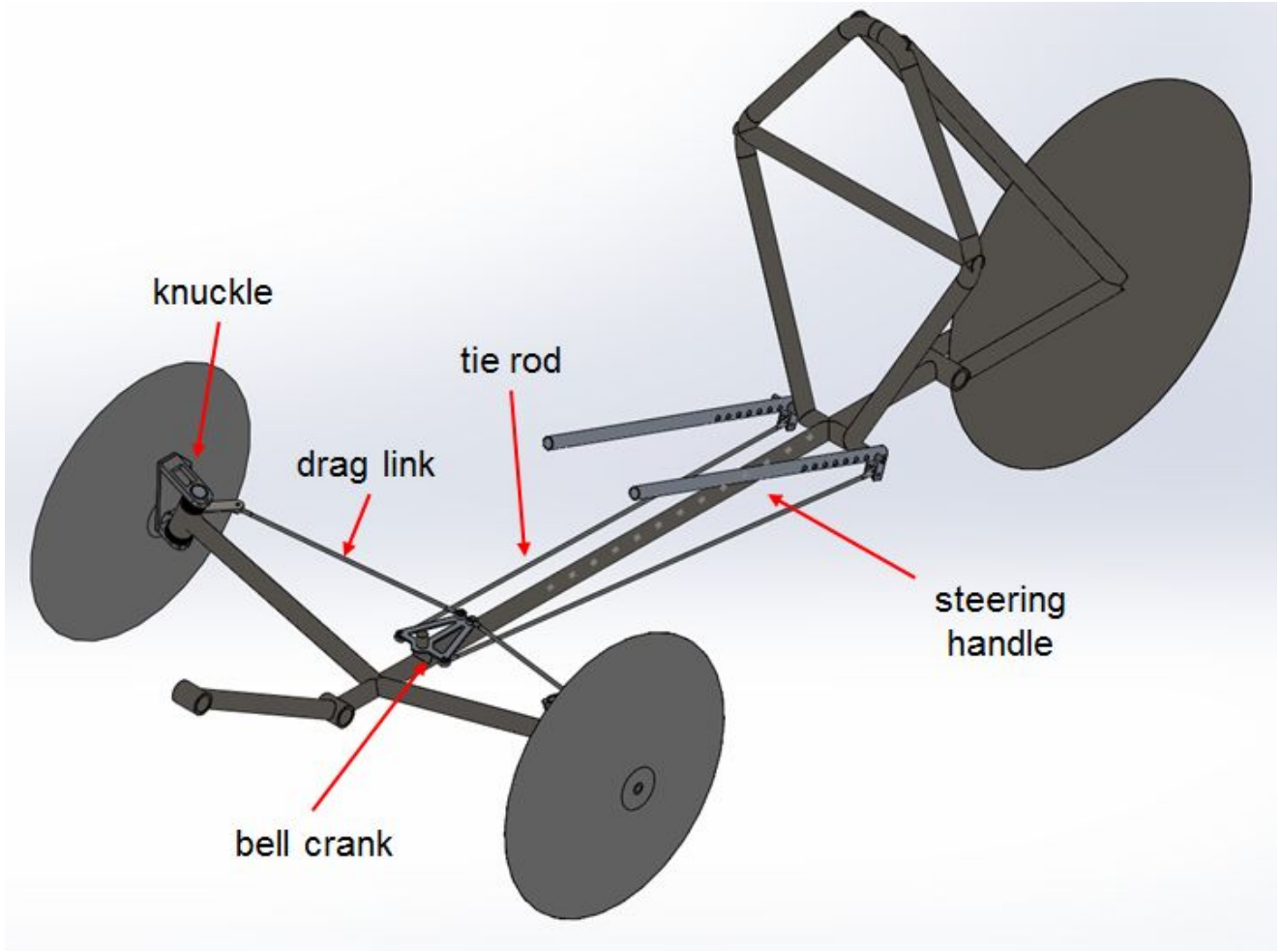
- Max deflection = 0.323 in.

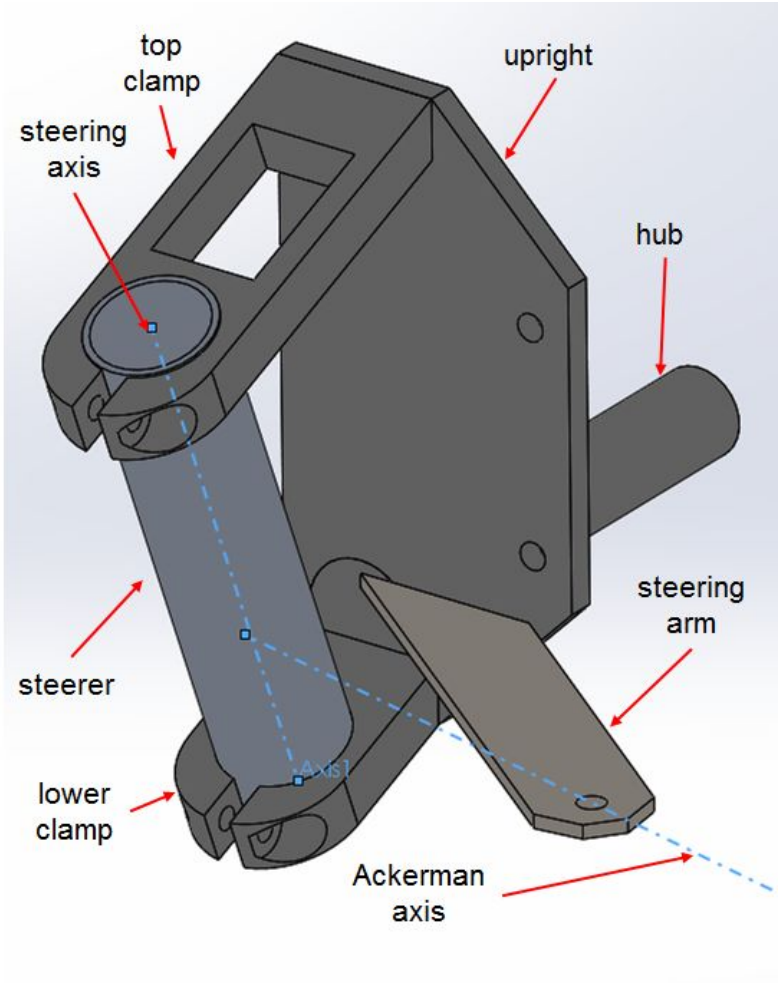


Weld Testing

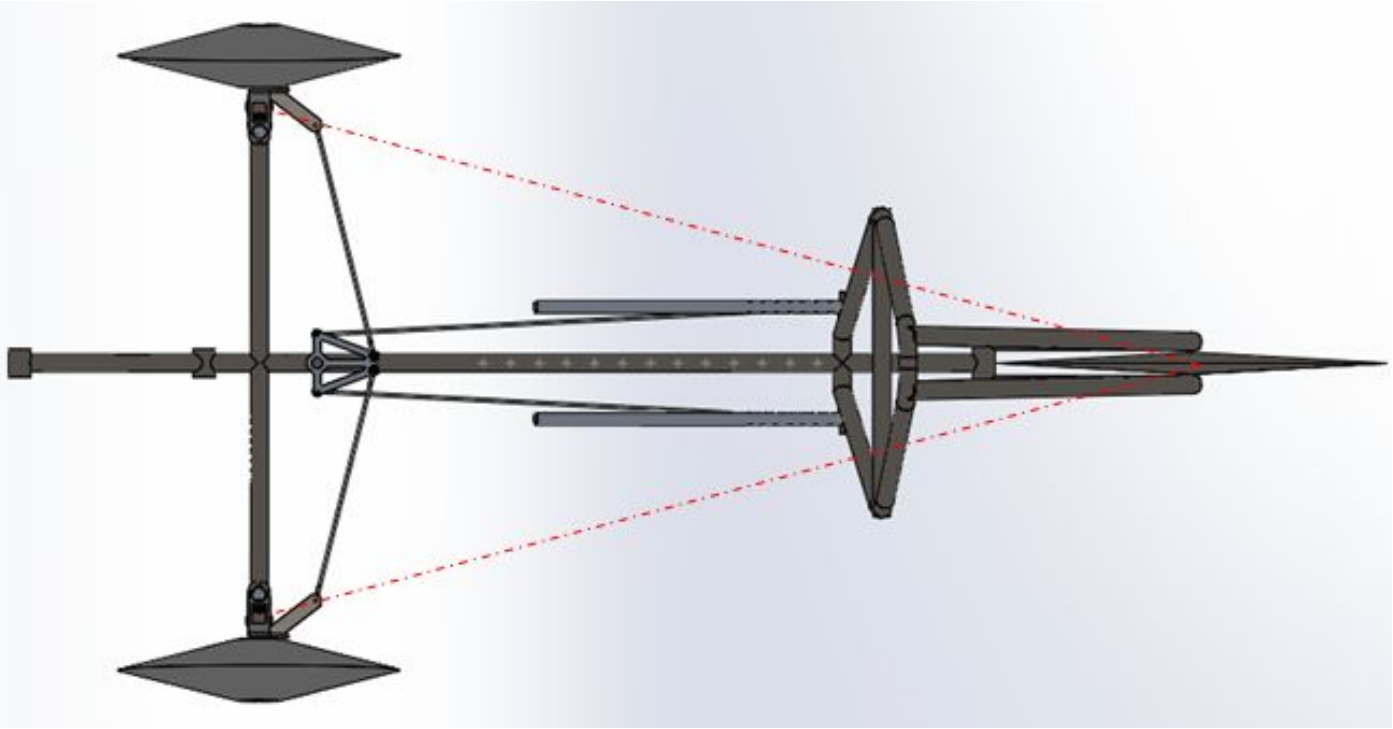
- Practiced welding material and breaking it
- Material broke before weld

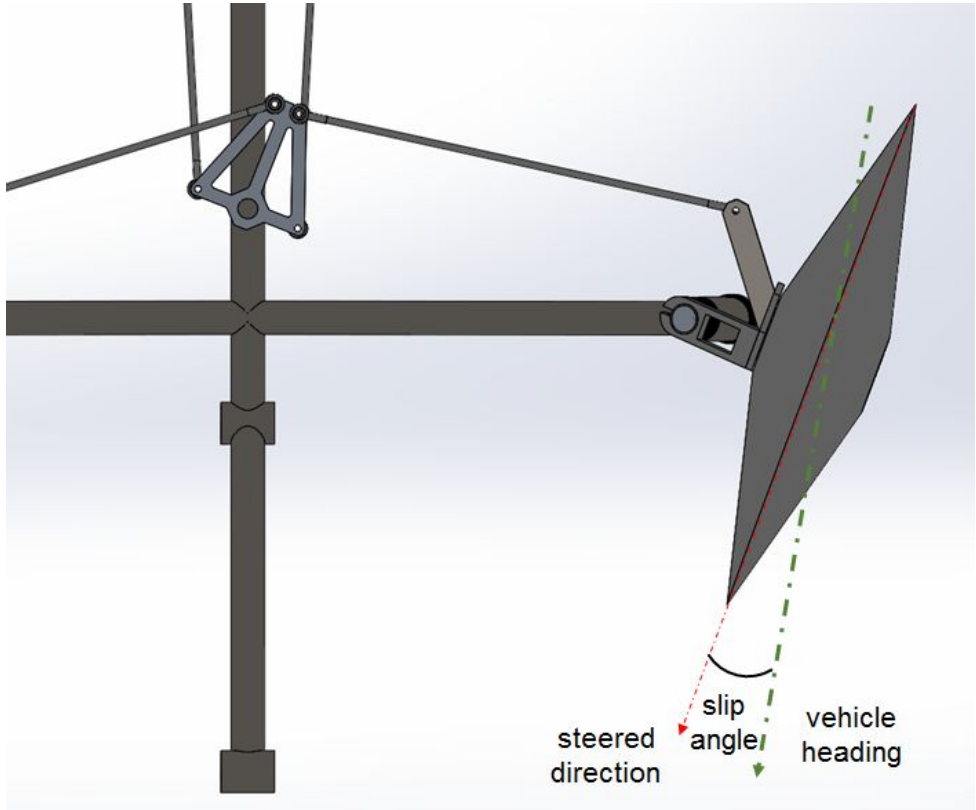
Steering Terminology





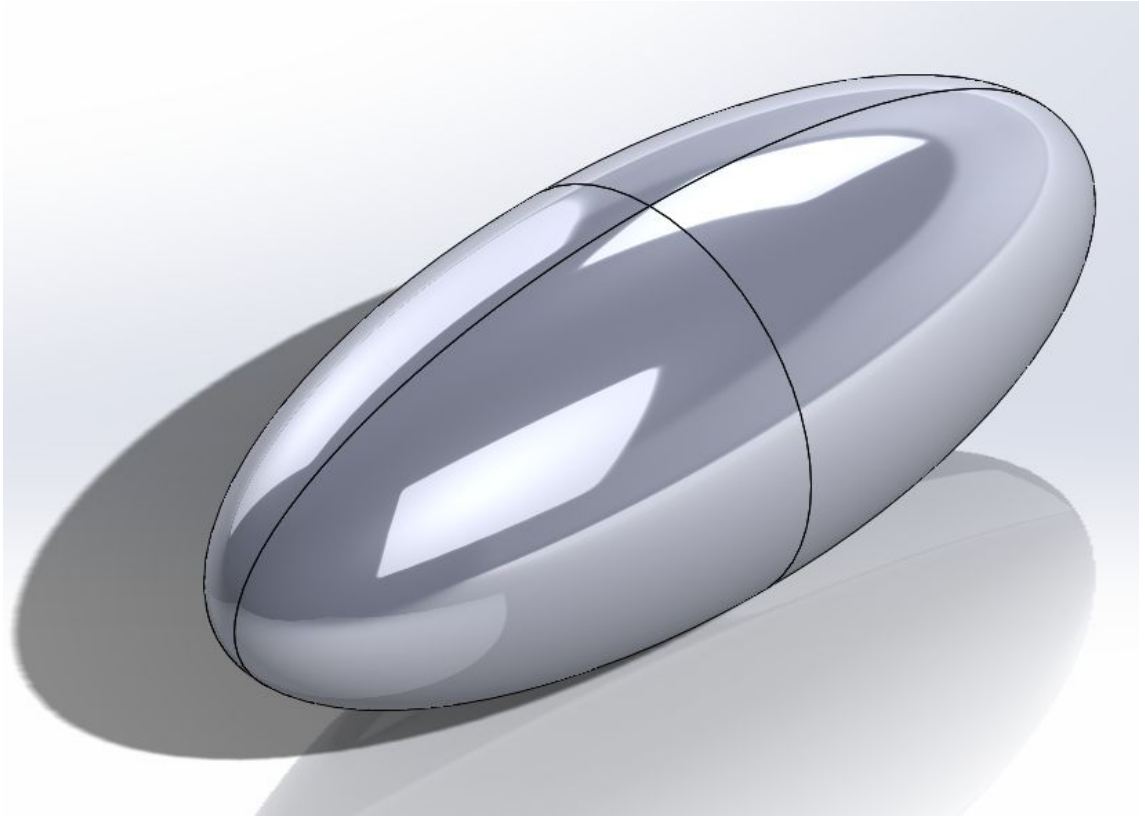
Ackerman Geometry





Fairing Plans

- Protect rider in event of a roll over
- Design considerations
  - Full encapsulation
  - Front windshield
- Help increase aerodynamic efficiency and reduce drag
- Material selection
  - Fiberglass vs carbon fiber
- Budget of approximately $2,500



Conclusions

- The Solidworks model has been thoroughly updated
- The project is on track for completion prior to competition, and is within budget
- Steel was used for the frame because of some material properties and what was available in our time constraint
- ANSYS stress analysis shows that the frame should have a maximum deflection of 0.323 in
- The steering system has been redesigned for efficiency and stability, and is almost complete
- The fairing should protect the rider and help reduce drag to increase the aerodynamic efficiency

References

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