Human Powered Vehicle

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Final Project Proposal

Overview

- Introduction
- Prototype
- CAD Model
- Frame
- Seating
- Fairing
- Steering
- TIG Welder
- Bill of Materials
- Conclusions

Introduction

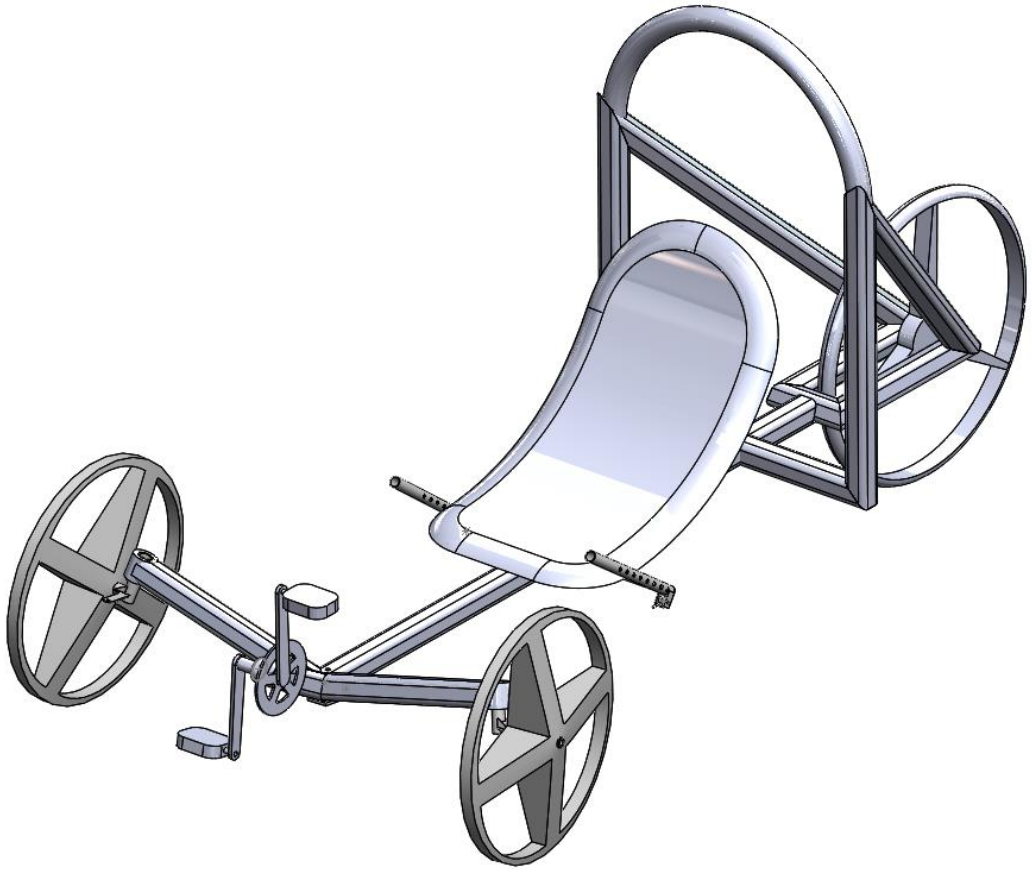
- There is a need for engineering efficient, reliable human powered vehicles in order for people to commute
- The goal is to eliminate vehicles by designing safe, efficient, and reliable vehicles that can be powered by humans
- The objective is to design this vehicle using the given criteria by the ASME 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
- Competition vehicles are typically made of metal alloys or composites, or a mixture of both, with a recumbent riding position and minimal aerodynamic effects
- The main criteria taken into account for the vehicle include the frame, steering, material, power input, fairing, and seating position

Introduction Continued

- Strength, weight, efficiency, and ease of manufacturing are among the most important design criteria
- Foot-pedal power alone will be used to propel the vehicle
- The seat will be one piece and adjustable for everyone on the team
- A laterally braced backbone frame will be built for the structure
- Steering will be accomplished with two levers, one on each side of the seat
- The frame will be made out of aluminum
- The project remains on schedule as of today

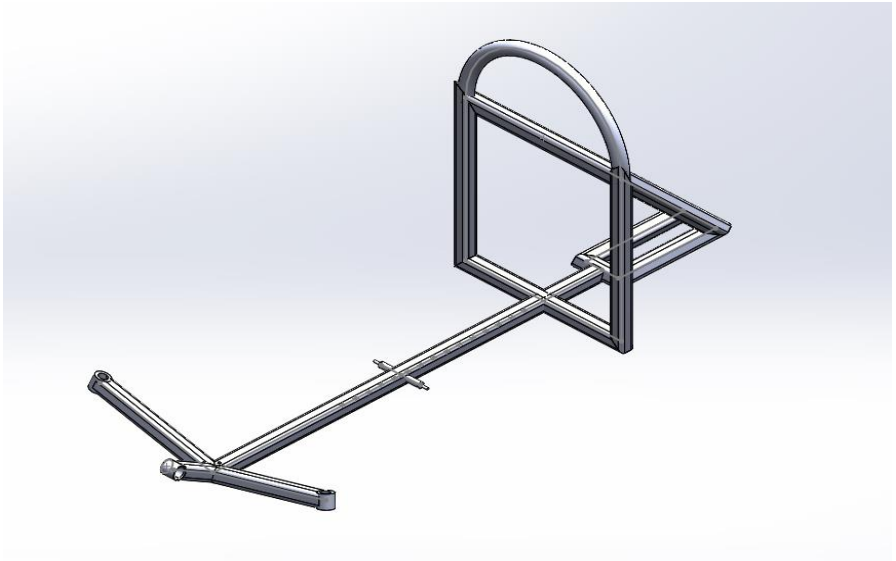
Prototype

CAD Model



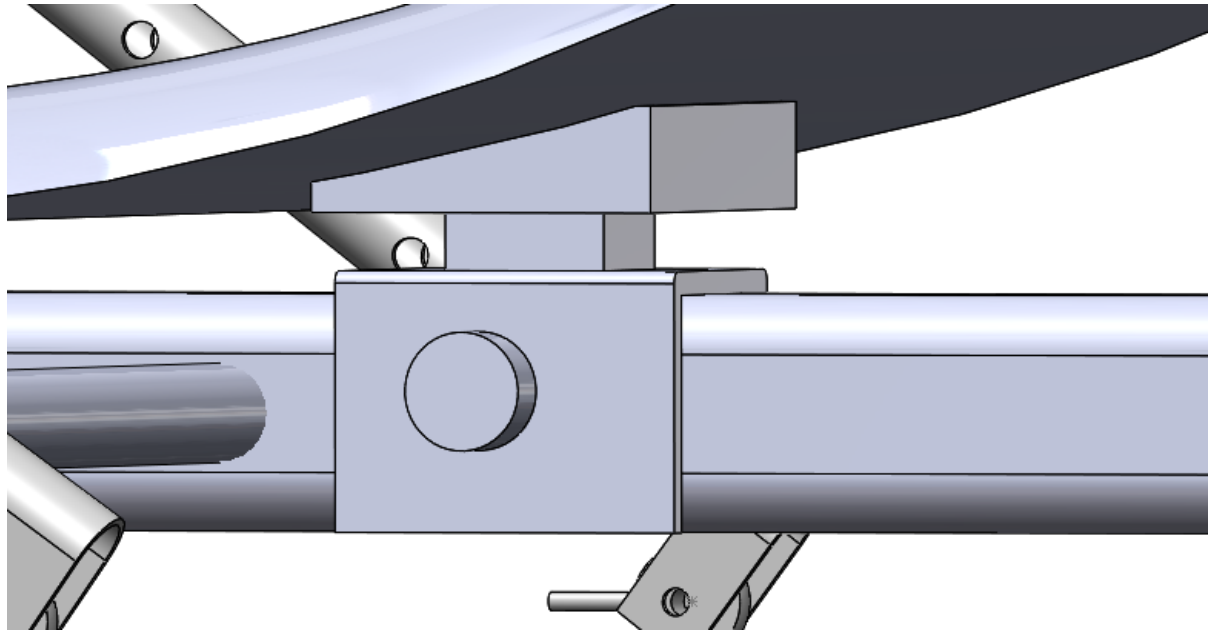
Frame

- Incorporates the use of triangular members to add strength
  - Single backbone design
- Constructed from aluminum to save weight
- Utilizes square tubing vs. circular
  - Ease of manufacturing



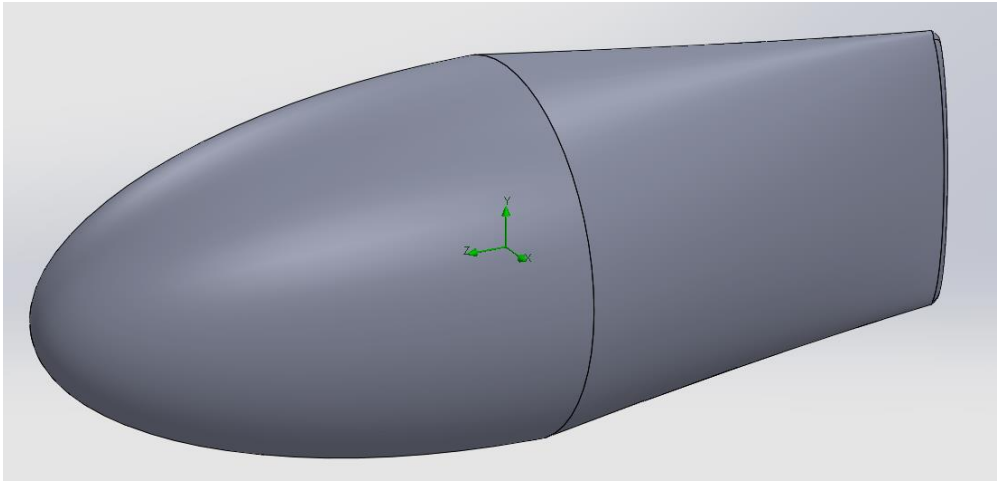
Seat

- Universal positioning bracket
- As light as possible
- Yet as comfortable as possible
- Correct posture



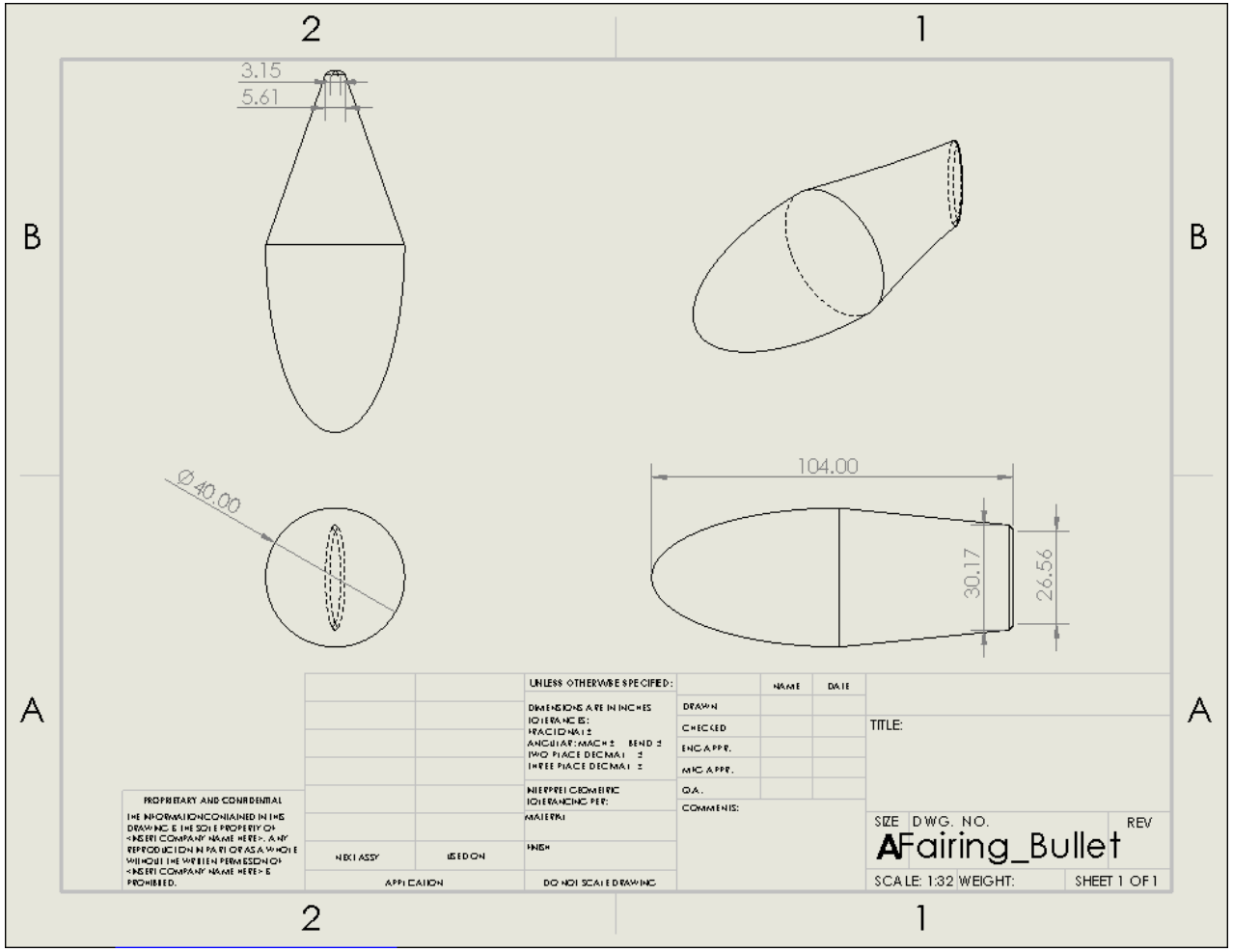
Fairing

- Used to make the vehicle more aerodynamic by having minimal coefficient of drag
- Previous model used a concave tail
  - Leads to reduce drag force
- Made out of carbon fiber
  - Strength to weight ratio



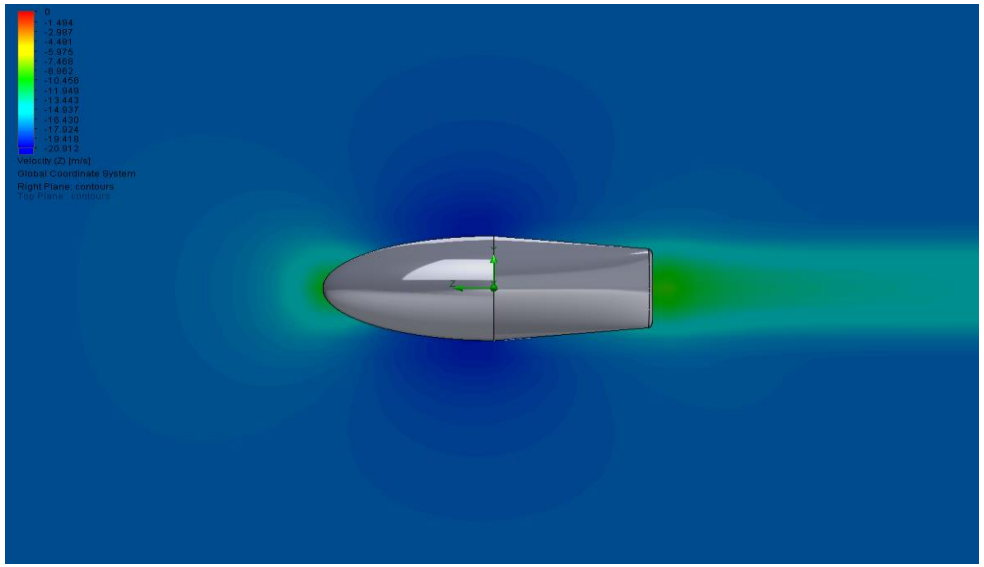
Fairing Continued

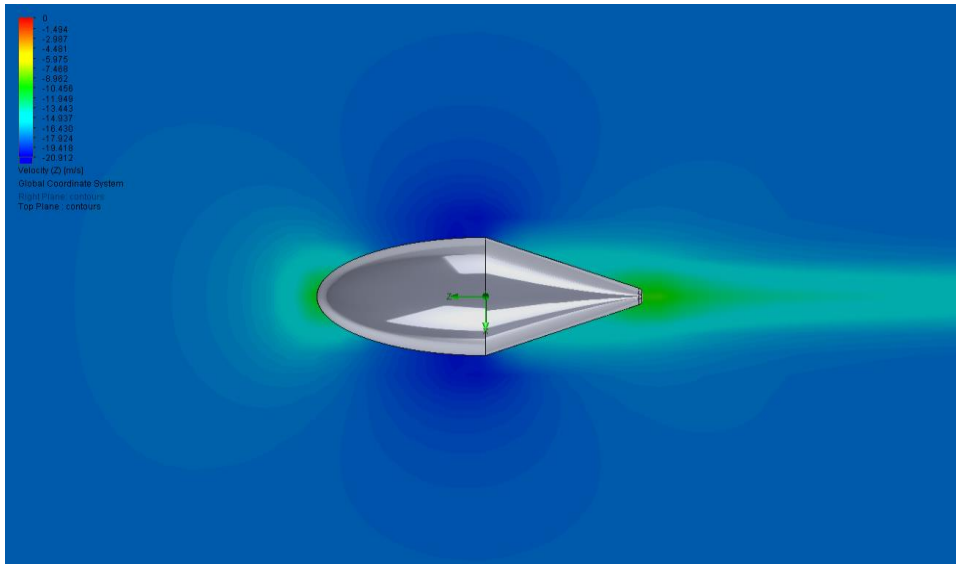
- Solidworks model
- Dimensions:
  - Length - 104 in
  - Width - 40 in
  - Height - 40 in
- Tail Stock:
  - Minimum Height - 26.56 in
  - Minimum Width - 3.15 in



Fairing Continued

- Computational Fluid Dynamics (CFD) done using Solidworks
- Assumptions:
  - Velocity of 40 mph
  - Air





Fairing Continued

- Coefficient of drag equation:
- Results:

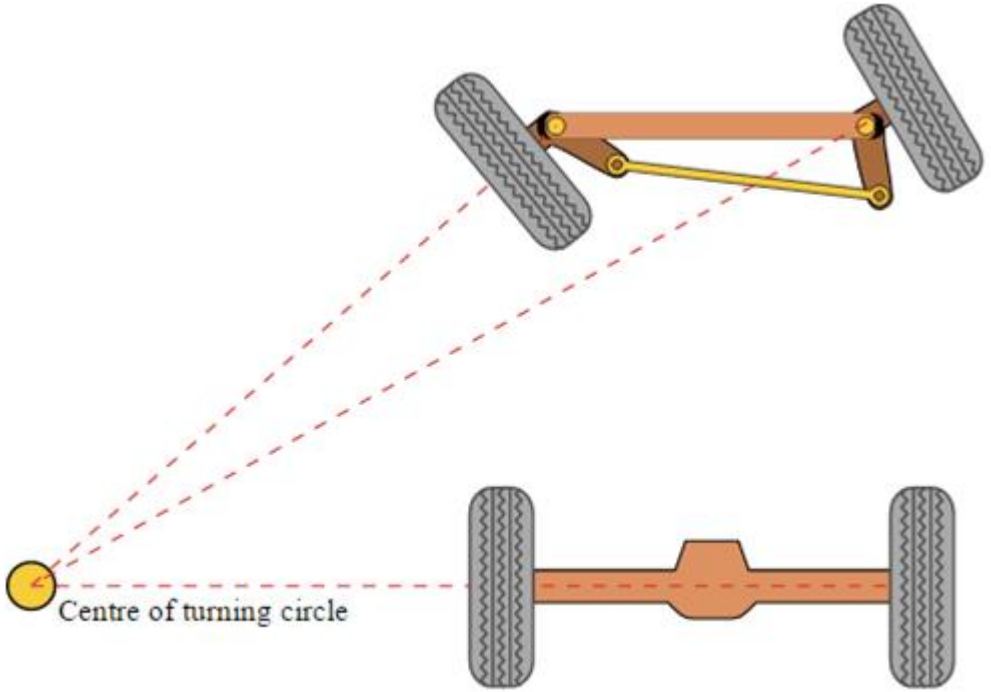
$$Cd = \frac{D}{\rho A V^2/2}$$

Goal Name	Unit	Value
Equation Goal 1	[ ]	-0.0451

https://www.grc.nasa.gov

Steering Geometry

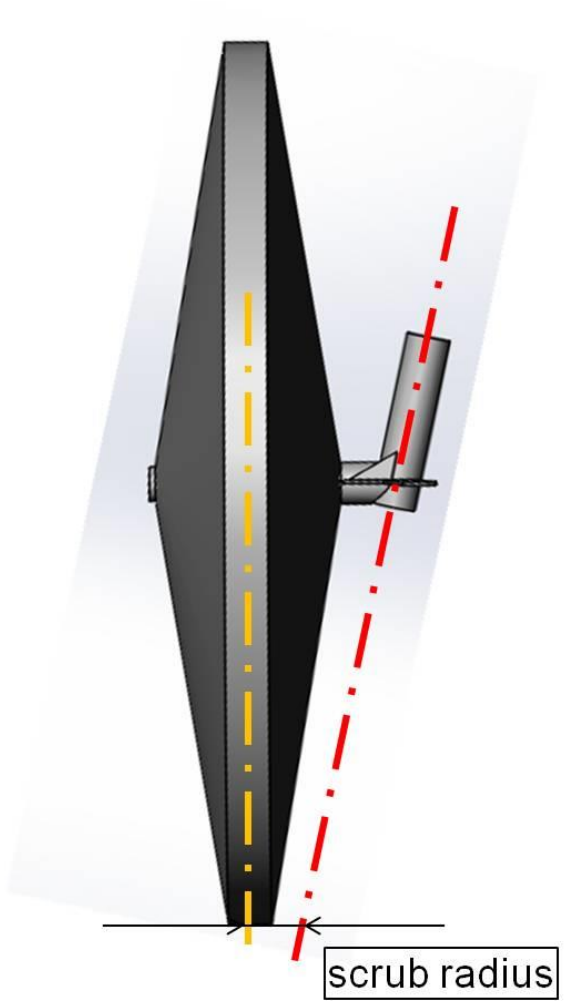
Ackermann steering: all wheels turn about the same center

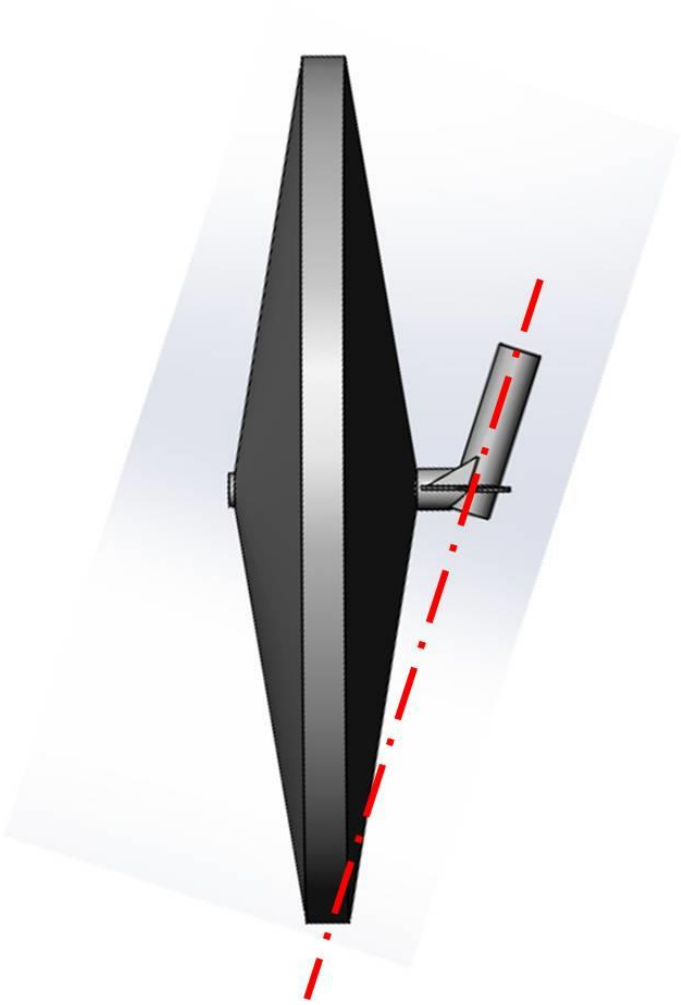


www.wikipedia.com

Steering Geometry Continued

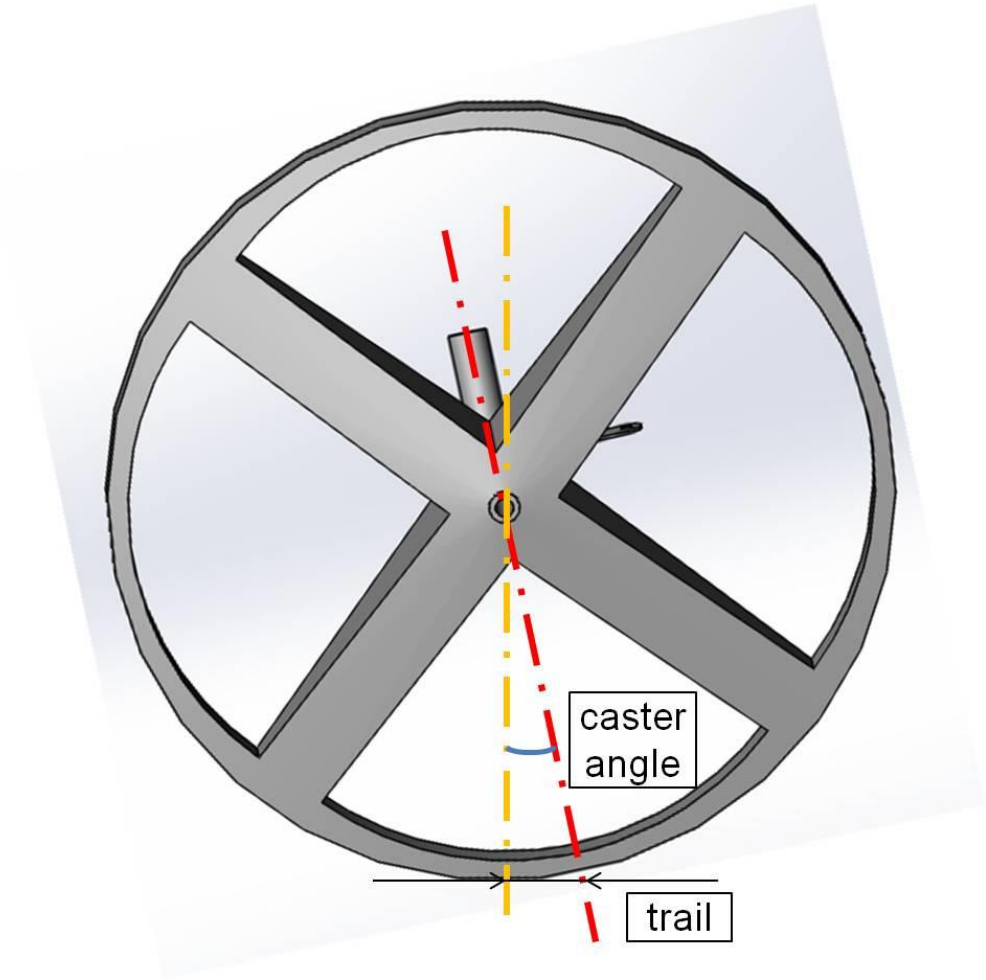
Zero scrub radius





Steering Geometry Continued

- Caster set at 12° with no rake for 2.13 inches of trail



TIG Welder

- The TIG welder overheated when the cooling system was not turned on before welding
- A new cooling system is in the construction process
  - Hardware: coolant pump
  - Fabrication time: two days

Bill of Materials

Bill of Materials			
#	Part Name	Quantity	Price $ (dollars)
1	Aluminum Tubing	27 (ft.)	14.14 per foot
2	Carbon fiber (Fairing)	20 (lb.)	11 per pond
3	Seat	1	130
4	Brakes	3	123.49
5	Pedals	2	31.49
6	Cranks	1	57.49
7	Chain	25 (ft.)	17.99 per ten ft.
8	Wheels	3	35.99
9	Tires	3	31.99
10	Lights	1	11.99
11	Battery	1	7.54
12	Horn	1	14
13	Shifters	2	48.99
		Total	$1,266.69

Conclusions

- The frame will be made out of aluminum to save weight, but it has triangular members to make it stronger
- The seat is made to fit any rider with a correct posture
- The fairing will have a concave tail shape just like the previous model, as it reduces drag
- All wheels turn about the same center with a zero scrub radius, which makes steering more accurate

References

- "24 Hour Human Powered Distance Record Attempt." 24 Hour Human Powered Distance Record Attempt. N.p., n.d. Web. 23 Sept. 2015.
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- "AtomicZombie - The Warrior Recumbent Tadpole Racing Trike." AtomicZombie - The Warrior Recumbent Tadpole Racing Trike. N.p., n.d. Web. 23 Sept. 2015.
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