NATHAN SU

MECHANICAL ENGINEERING PROJECT PORTFOLIO

PERSONAL PROJECTS

KrazyKart

Objective:

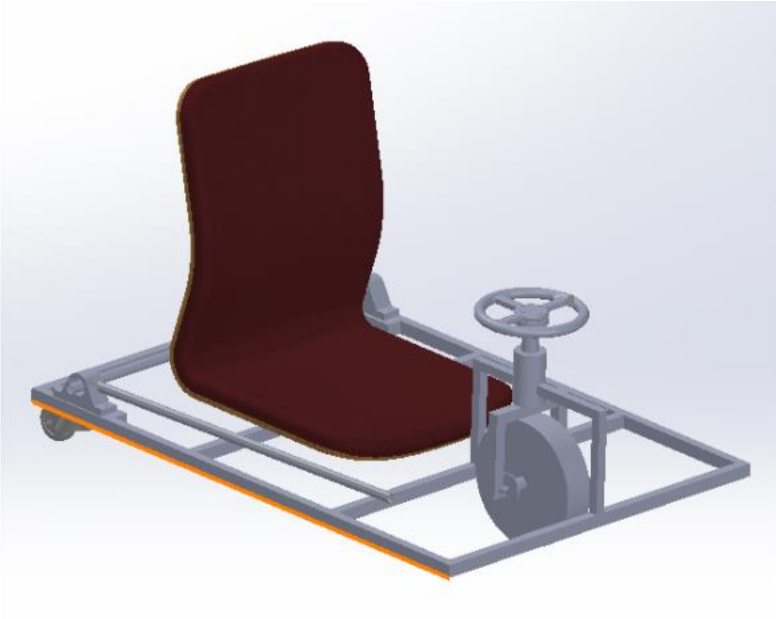
- Build my own "KrazyKart" drift go-kart from complete scratch

Design & Mfg. Process

- Designed kart in CAD, starting w/ the frame, then adding components in assembly
- Bought materials + parts and started manufacturing based on CAD model and drawings
- Welded the frame, soldered electrical connections, programmed Arduino

Final Design

- Fully functional drifting go kart which is very fun to ride



Scan for full detailed Engineering Report

Mechanized Baseball Pitcher

Objective:

- Make a baseball pitching machine that could launch a baseball around 40mph from a little league pitching mound.

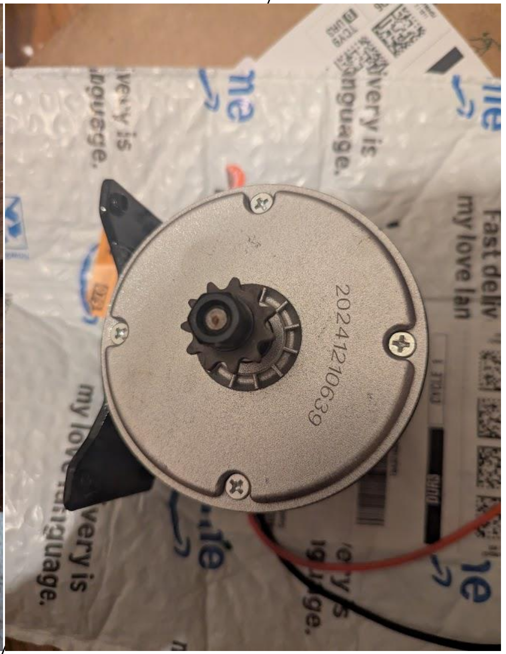
Design Process

- Calculate the required motor RPM and wheel speed to achieve the desired ball speed
- Make a CAD model and drawings to reference for manufacturing
- 3D print necessary parts, use wood for the frame, assemble

Final Design

- Consistently delivers pitches at a moderate speed from the desired distance, making hitting the ball easy and fun

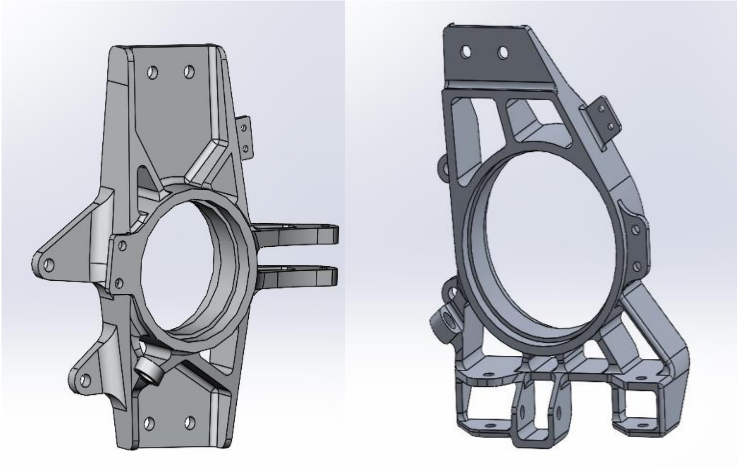
Video of it in action



FSAE PROJECTS

HUBS AND UPRIGHTS SYSTEM

UPRIGHTS



KPI	Point Weight	Old 3 (Datum	New 3 V2
Weight	3	0	-1.504
Max Stress	1	0	-0.41
FOS (Combined)	4	0	-0.36
FOS (Corner)	2		5.843
FOS(Brake)	2		0.226
Max Deflection(Comb)	3	0	3.158
Max Deflection(Corner)	1.5	0	5.928
Max Deflection(Brake)	1.5	0	3.723
Fatigue Resistance	4	0	-0.5
Total		0	27.7265
Point System: Percentage x 10			

Previous Generatively Designed Uprights

- Complex and expensive to manufacture
- Low factors of safety
- Did not align with overall vehicle goal of:
  - Reliability, simplicity

Design Process for New Uprights

- Built on design from two years ago
- Easier to manufacture (almost all CNC Mill cuts can be done in 3-axes)
- Tried and true design from previous years; underwent lots of testing and driving hours
- Added tire temperature, brake temperature, and wheel speed sensor mounts to collect vehicle performance data

Validation

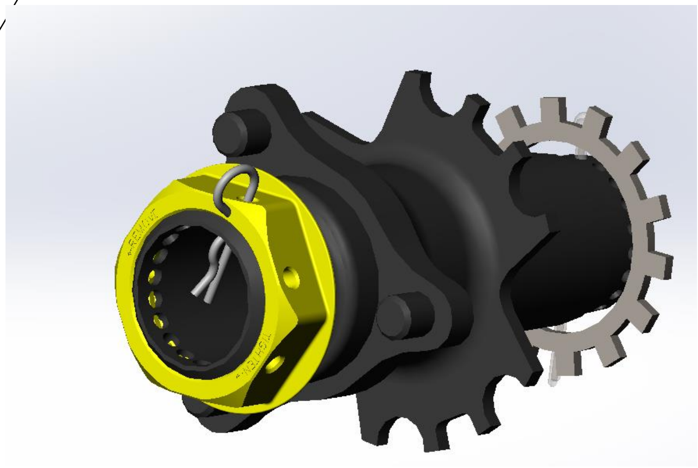
- Created Pugh's design matrix to objectively compre designs based on KPIs
- Validated how new design was better than the previous
- Performed FEA and fatigue analyses to compare using force inputs from IMU and OptimumG software

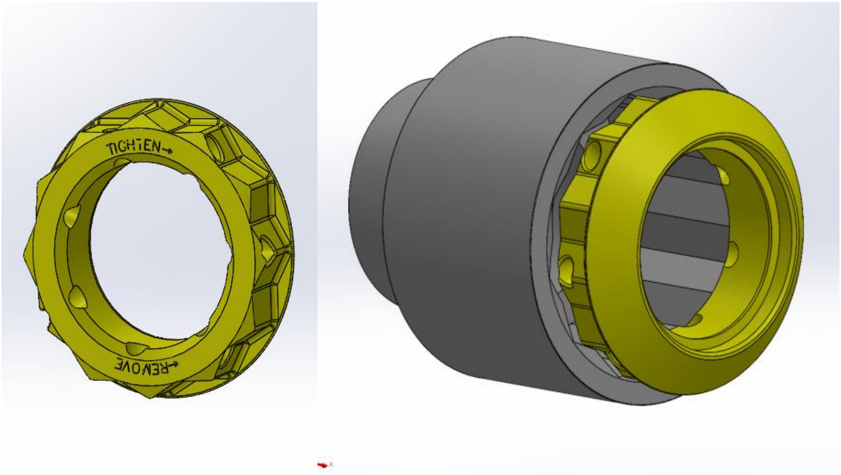
Finished Product

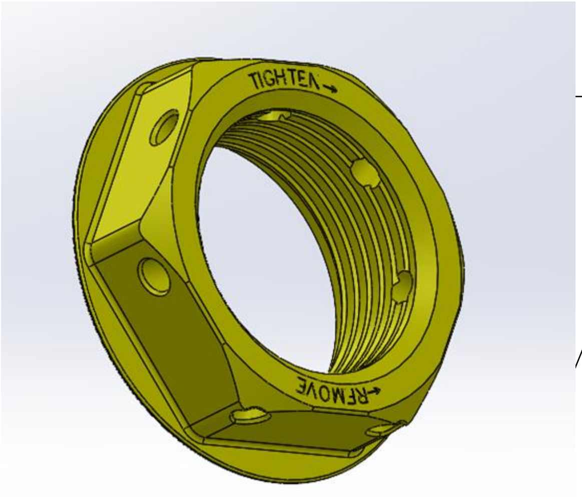
- Manufactured by team sponsors Aether Machining & EEE Machining

HUBS AND UPRIGHTS SYSTEM

HUB ASSEMBLY







Hub

- Reused previously spare set of hubs to stay within tight budget
- Revalidated design by performing FEA and fatigue analyses using updated forces

Wheel Nut

- Previous design had a hole alignment issue for the safety pin
- Redesigned new wheel nut to have over 3x the chance to align with the holes on the hub itself by giving it 7 equally spaced holes opposed to previous 6
- First design was a 12 point
- Would need to new 12-point socket in obscure (very large) size

Final Wheel Nut Design

- 6-point with 7 equally spaced holes
- Final design allows us to use the same socket as well
- Decreases wheel changing times and leads to more testing time

INTAKE PLENUM PROJECT

Objective:

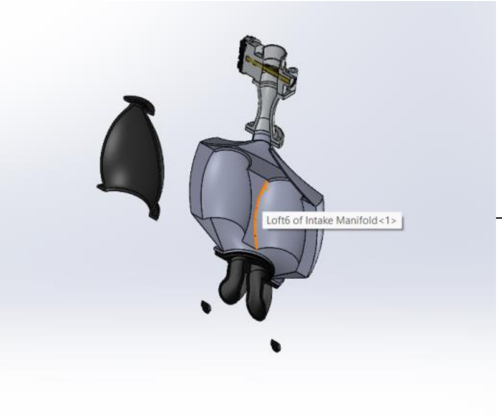
- Design new intake plenum which overall gives a better mass flow rate, allowing for the engine be able to make more power
- Improve engine throttle response

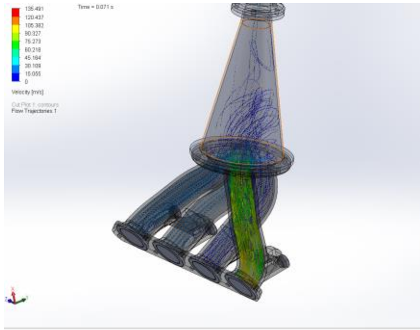
Design Process

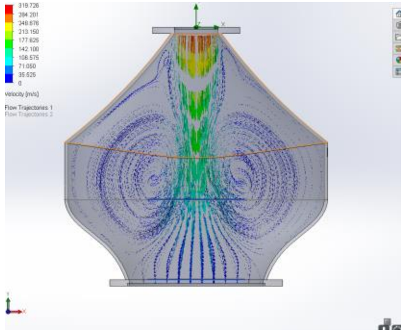
- Created a “double plenum” based on an idea of a teammate
- Validated mass flow rate, velocity, and pressure using SolidWorks Flow Simulation (CFD)
- Experimented with a variety of different tube shapes, changing parameters to get the best results

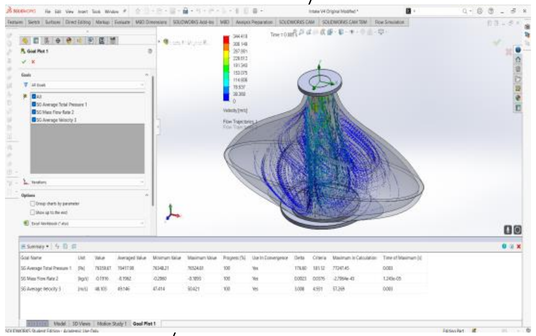
Final Design

- Mass flow rate of .211 kg/s, improved compared to 0.2 of original intake
- 3D printed prototype to be tested, but was never tested due to lack of time preparing for internation competition

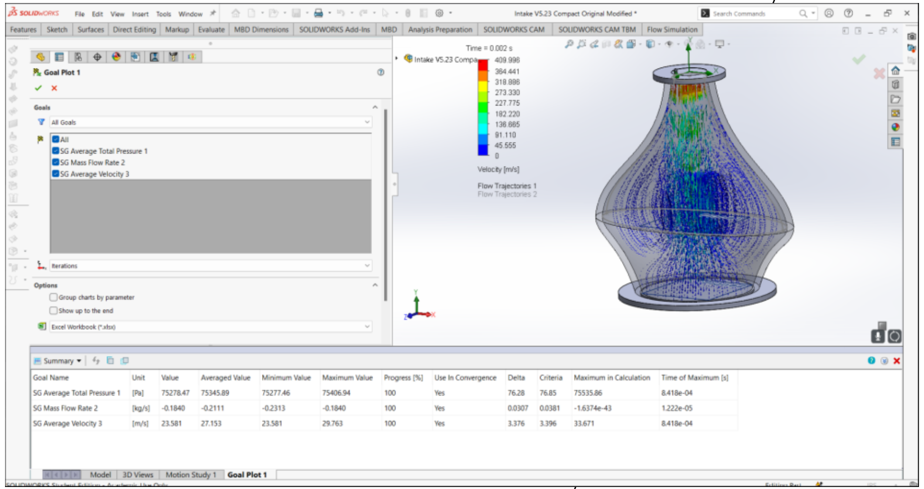








Final Design



Clevis Project

Objective:

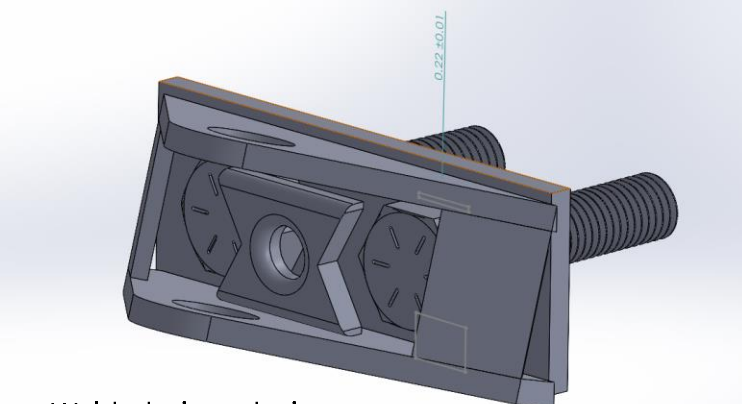
- Restrain bolt heads to prevent bolt from spinning when tightening nut onto it

Design Process

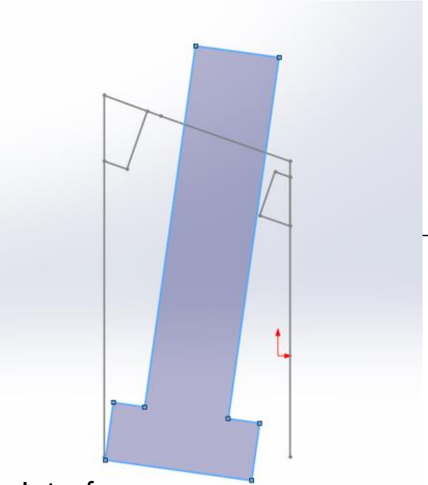
- Thought about welding pieces to the steel clevis to secure bolt head
- Decided machined aluminum clevises were easier and more precise
- Added material to opposing bolt head faces, but machining would have been a challenge

Final Design

- Aluminum machinable clevis with shelf to hold bolt heads in place, while still allowing the bolts to be removed

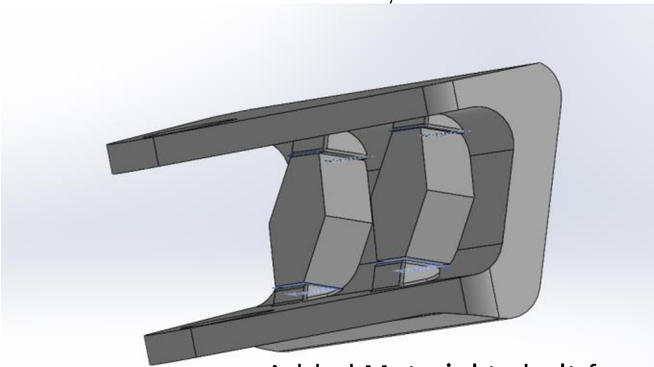


Welded piece design



Interference check

Final Design



Added Material to bolt faces

THANK YOU

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