EECS 149 – Parts Justification

Microcontroller: ESP32-WROOM32UE

- Prototype-friendly microcontroller with 18 ADC measurement inputs and 1 CAN input
- Analog inputs needed for steering input potentiometer and IMU
- Supports Arduino IDE for development in C

Motor: 131:1 Metal Gearmotor 37Dx73L mm 12V with 64 CPR Encoder

Forces (in lb-f) acting on upright as calculated in Loadcases.m MATLAB Script:

https://github.com/Meghd2cx/EECS149-AdjustableCamber/blob/main/Loadcases.m

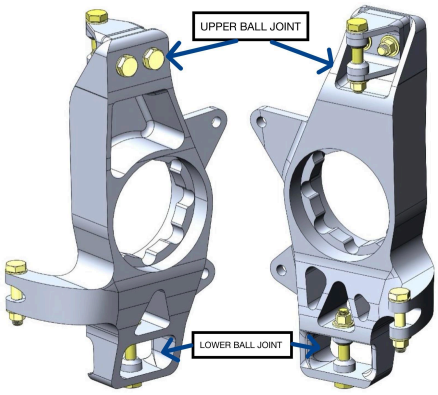
Script generates front and rear loads, factoring in lateral and longitudinal load transfer.

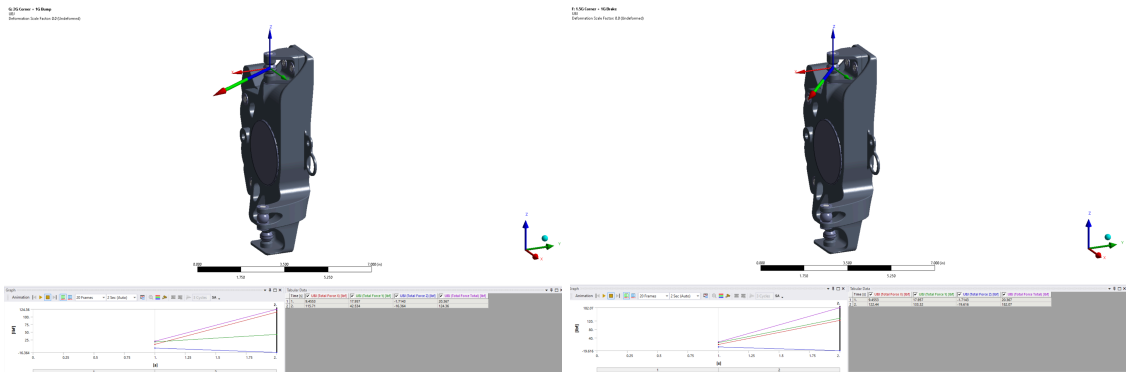
	PneuT_X	PneuT_Y	PneuT_Z
Front_Cornering_Outside	0	-415	279.18
Front_Cornering_Inside	0	74.055	49.819
Front_Braking	435.6	0	284.04
Front_Reverse_Braking	-257.4	0	55.865
Front_Bump	0	0	417.5
Front_Compound_1	198	-311.25	338.49
Front_Compound_2	0	-415	418.35
----------	0	0	0
Rear_Cornering_Outside	0	-561.18	377.52
Rear_Cornering_Inside	0	49.766	33.479
Rear_Braking	169.4	0	85.964
Rear_Reverse_Braking	-100.1	0	219.14
Rear_Bump	0	0	502.5
Rear_Compound_1	77	-420.89	322.22
Rear_Compound_2	0	-561.18	545.02

Expected conditions:

```
% # of Gs
CO_G = 2; % Cornering Outside (# of Gs)
CI_G = 2; % Cornering Inside (# of Gs)
Br_G = 2.2; % Braking (# of Gs)
RB_G = 1.3; % Reverse Braking (# of Gs)
Bump_G = 3; % Bump (# of Gs)
```

Applied loads to upright to determine forces on upper and lower ball-joint points:

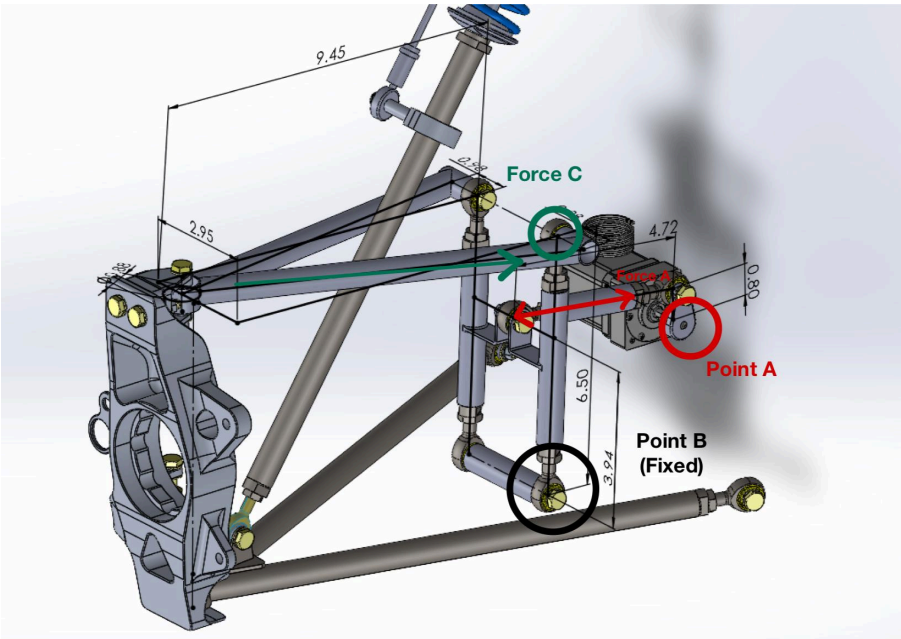




Upper ball joint forces:

[Total Force X] 122.44 lbf, [Total Force Y] 133.332 lbf, [Total Force Z] -19.62 lbf

Scale down loads by factor of **10** to limit costs and enable 3D-printing since this is a proof-of-concept prototype.



Motor stall torque = 39.375 lb-in, or 45 kg·cm

Required continuous torque within 60% of stall torque

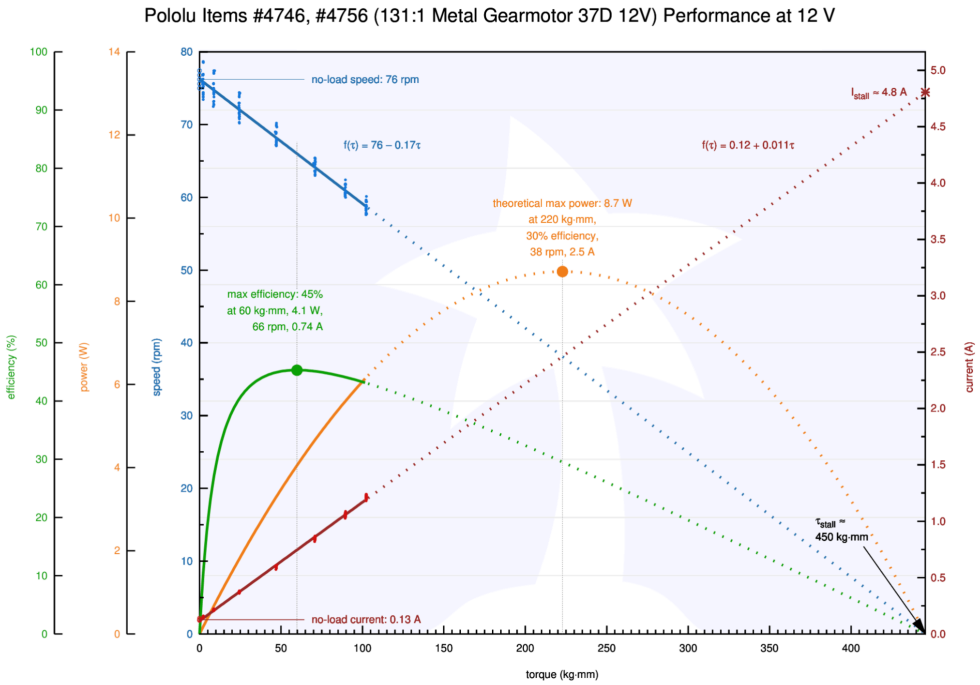
A: 23.625 in-lbf = 0.80 in * Force A

Force A = 29.53 lbf

B: 29.53 lbf * 3.94 in= Force C * 6.50 in

Force C= 17.9 lbf

Motor specifications



Pololu Dual VNH5019 Motor Driver Shield for Arduino

- Chosen according to current draw of motor
    - Can support 12A per channel
- Capability to support another motor if needed via H-bridge
- Compatible with 12V battery

Remaining parts on BoM were chosen to ensure compatibility with Formula SAE racecar (existing suspension hardware and electronics, such as steering potentiometer, battery, and IMU) and minimizing cost (3D-printing where possible) to make a proof-of-concept prototype. Materials would be chosen to be more robust if this system were to be actually integrated on the car.