

Automotive Utility Transport for Individuals:

City Mobility

Senior Research 23-24

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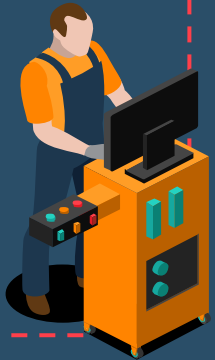
Future Research



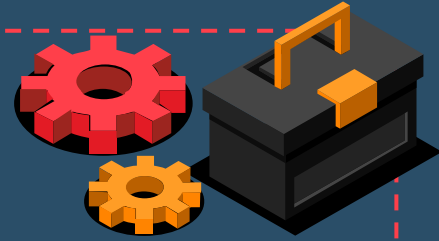


01

Objectives of AUTI:CM



Objectives



Purpose

Create a compact, maneuverable, single-person electric vehicle that is can carrying a bag in response to concerns with the weight, size, and maneuverability of standard electric go-kart models.



Goals

- 25 sq. ft. footprint
- Two-wheel steering system
- Carries a single person and bag
- Operable at 15 mph
- Completed four-wheel steering model





Project Timeline



Research

Nov. 2023



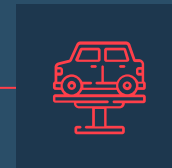
Material Acquisition

Dec. 2023 - Mar. 2024



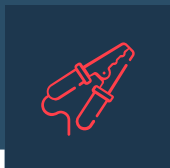
Steering Completion

05 Apr. 2024



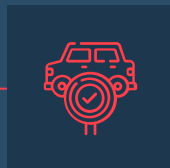
Chassis Completion

03 May 2024



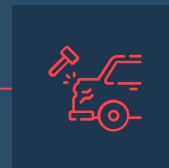
**Electronics
Completion**

13 May 2024



Final Assembly

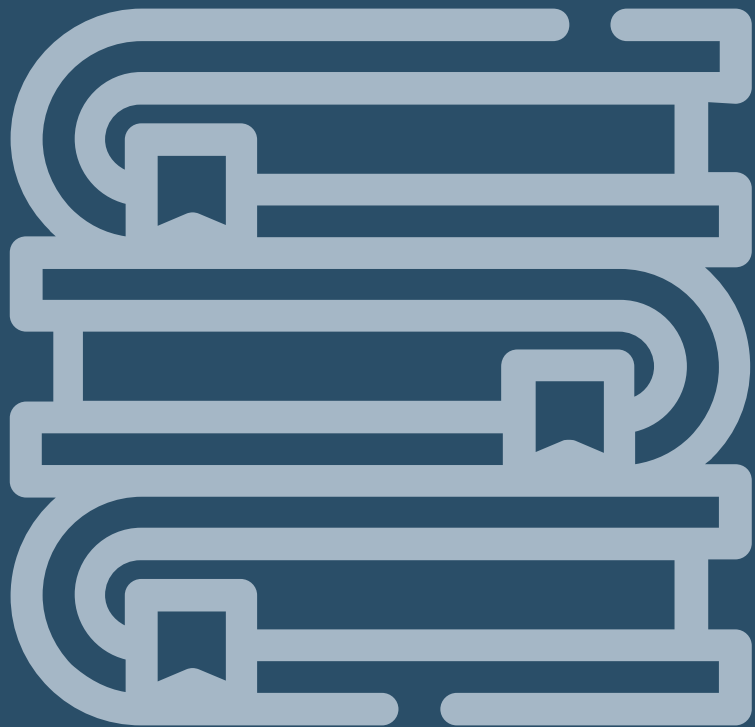
14 May 2024



Testing

15 May 2024





02

Background Research



Literature Review

- Criticized for weight, size, and maneuverability
 - Aluminum extrusions for weight and size
 - Hub motors and four-wheel steering model for maneuverability
- How four-wheel steering works
 - Why it was not implemented into the final product
- Two-wheel steering go-kart design
 - Lack of rack-and-pinion model

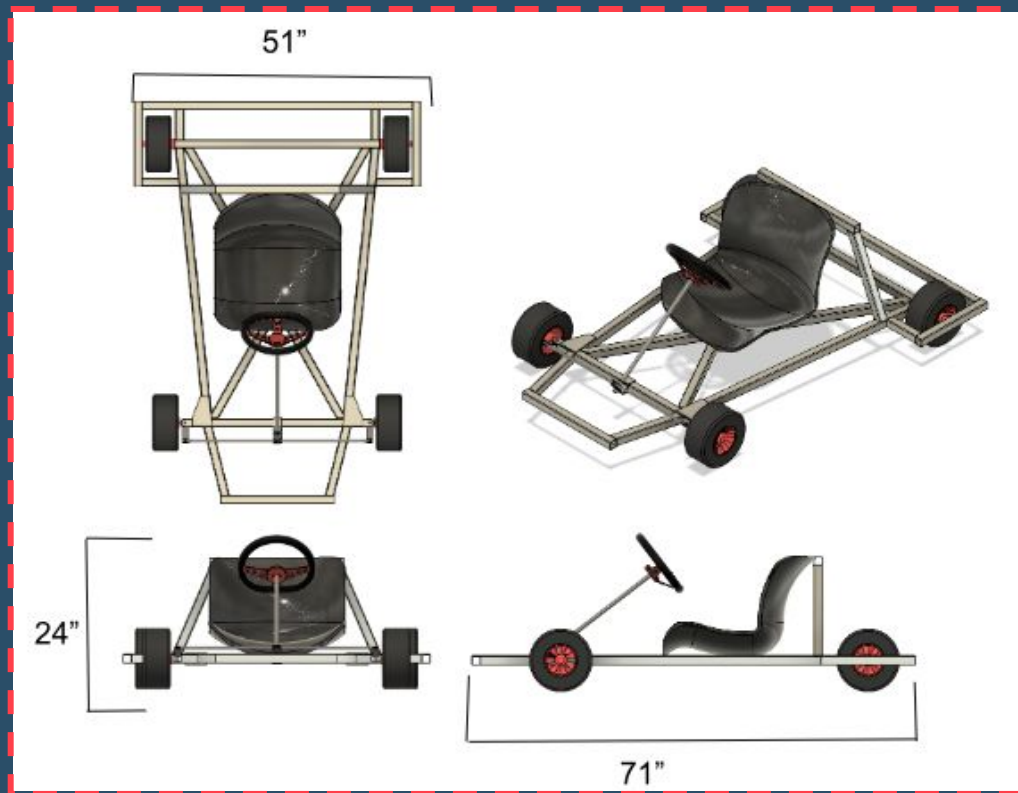




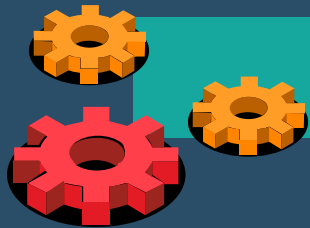
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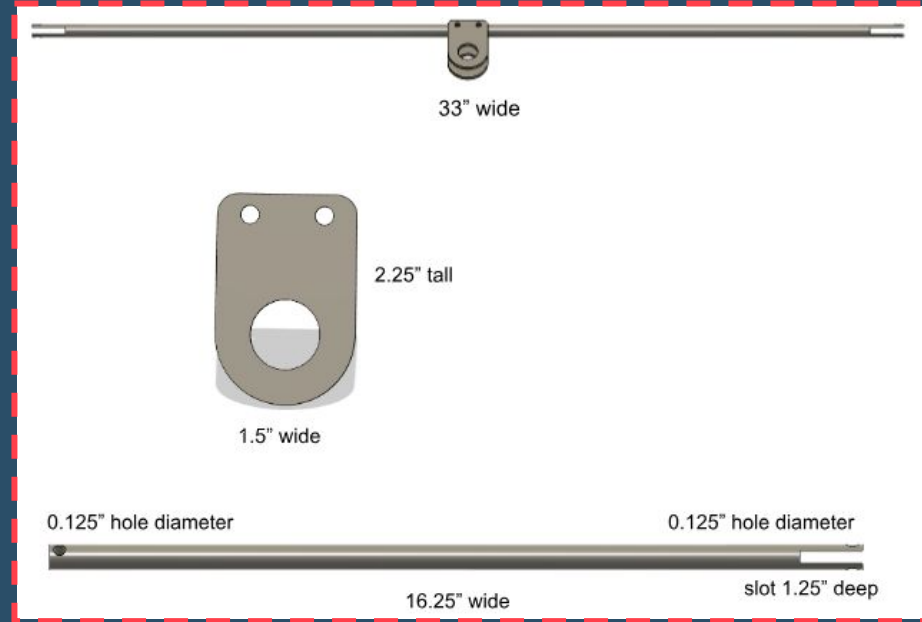
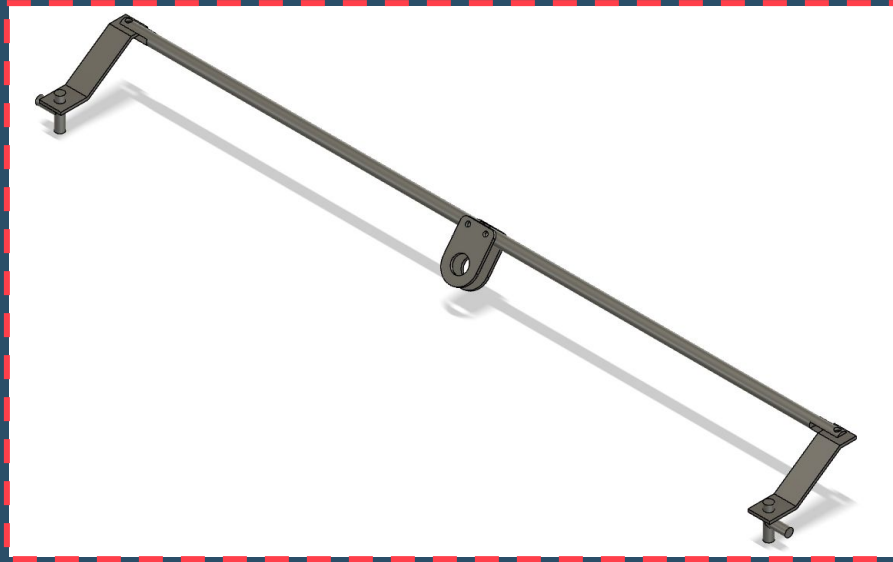
Designs





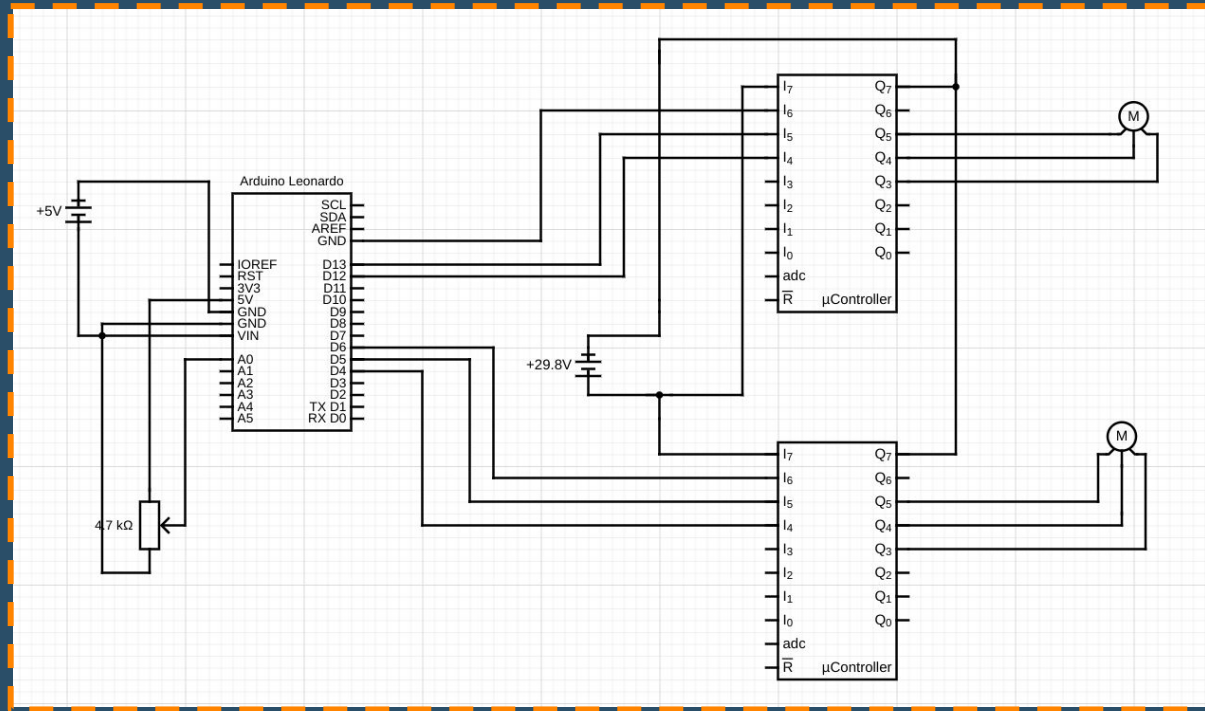
GO-KART CAD



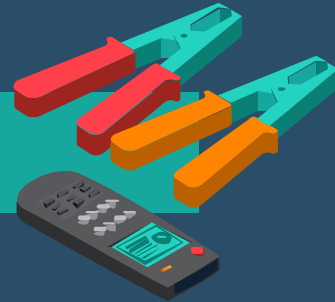


STEERING SYSTEM



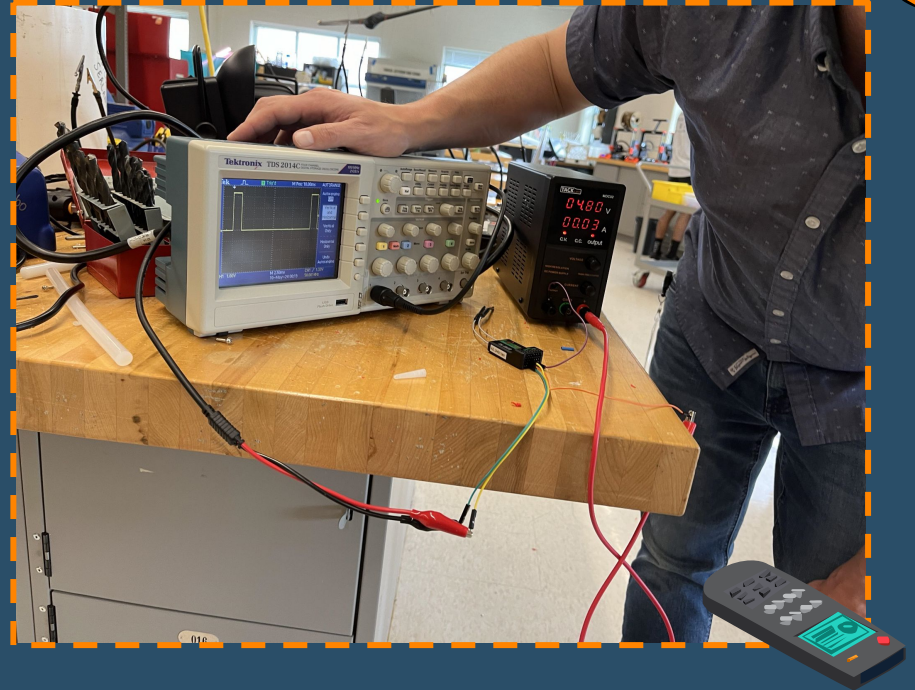


ELECTRONICS DIAGRAM



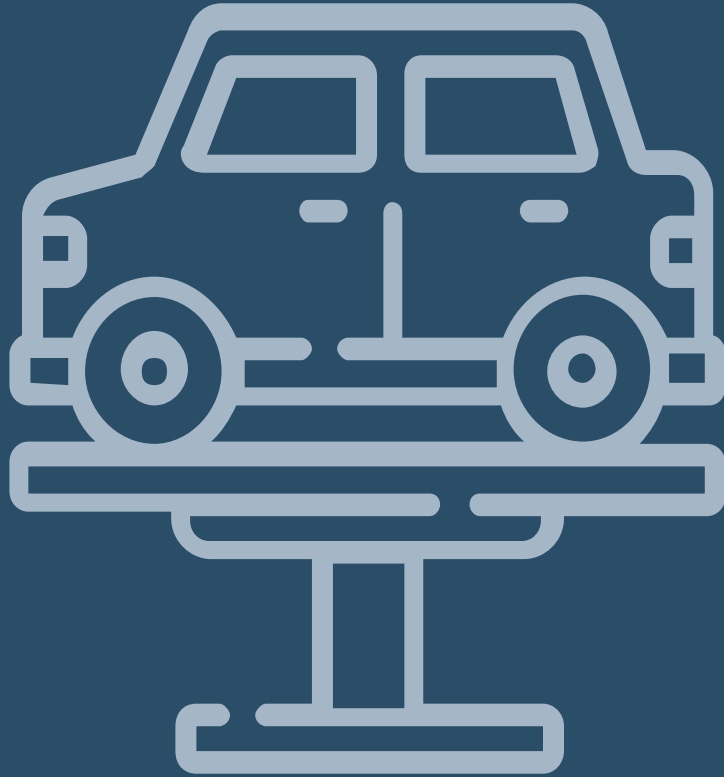
Electronics Explained

- RC
 - Range of 45-180
- Hall effect sensor
 - Range of 180-650

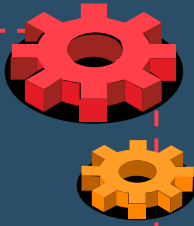


04

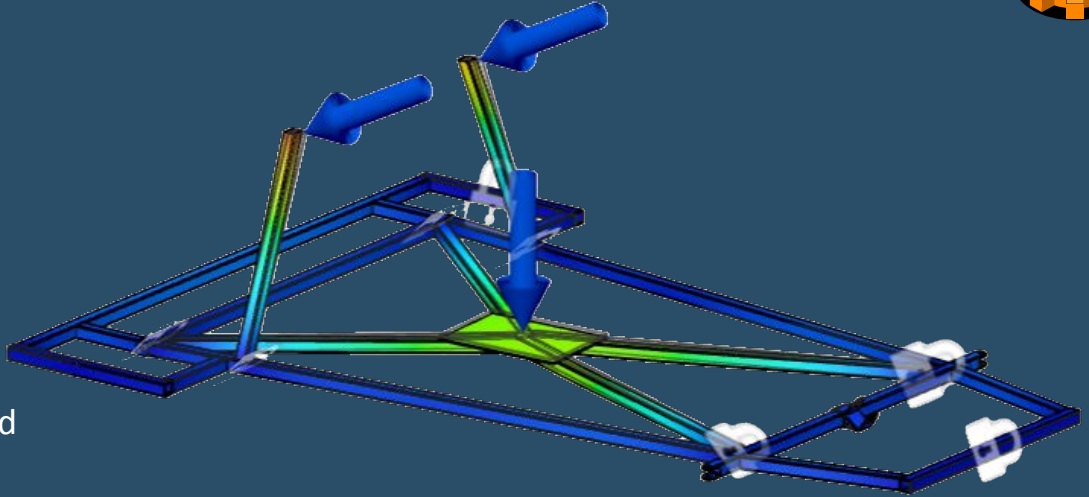
Testing & Manufacturing



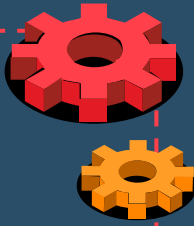
Seating Stress in Fusion 360



- Seat Holders
 - 900 N of force $\approx$ force of seated 200 lbs person
 - Max Displacement $\approx$ 1.3 cm
- Base
 - 1800 N of force $\approx$ force of seated 400 lbs person
 - Max Displacement $\approx$.7 cm



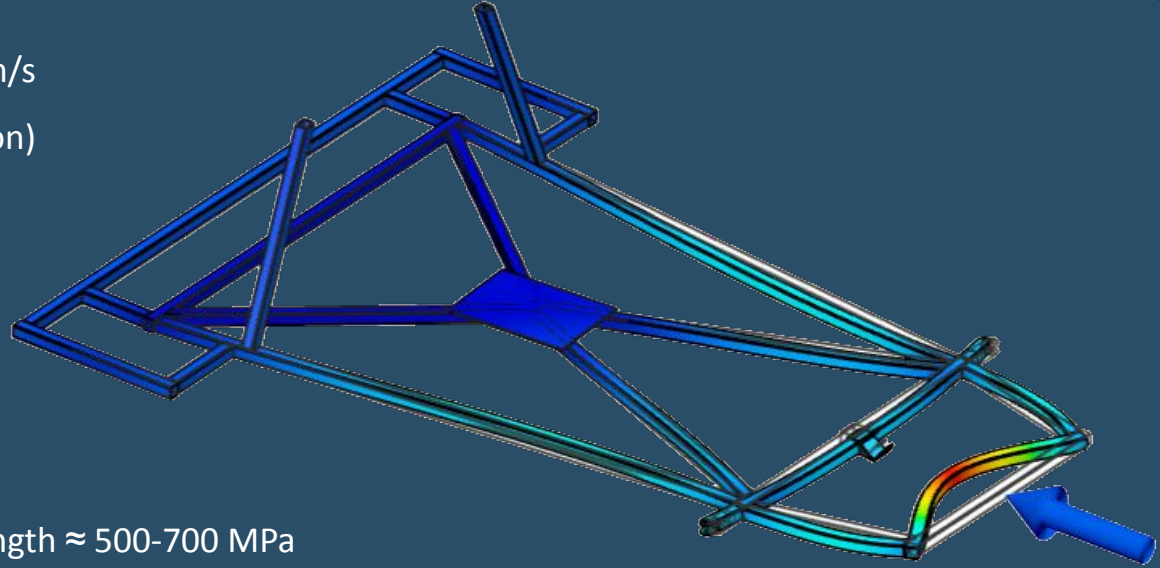
Crash Testing in Fusion 360

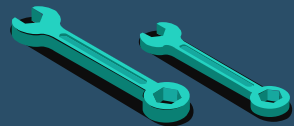


- Velocity = 30 mph $\approx$ 13.5 m/s
- Mass $\approx$ 110 kg (90 kg person)
- $P \approx 1485 \text{ N} \cdot \text{s}$
- $t = .1 \text{ s}$
- $F \approx 15,000 \text{ N}$

Max Pressure = 1,300 MPa

Aluminum Extrusion Tensile Strength $\approx$ 500-700 MPa





FINAL GO-KART ASSEMBLY



05

Discussion

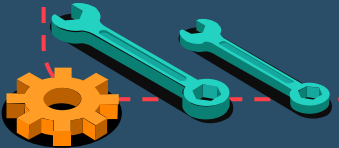
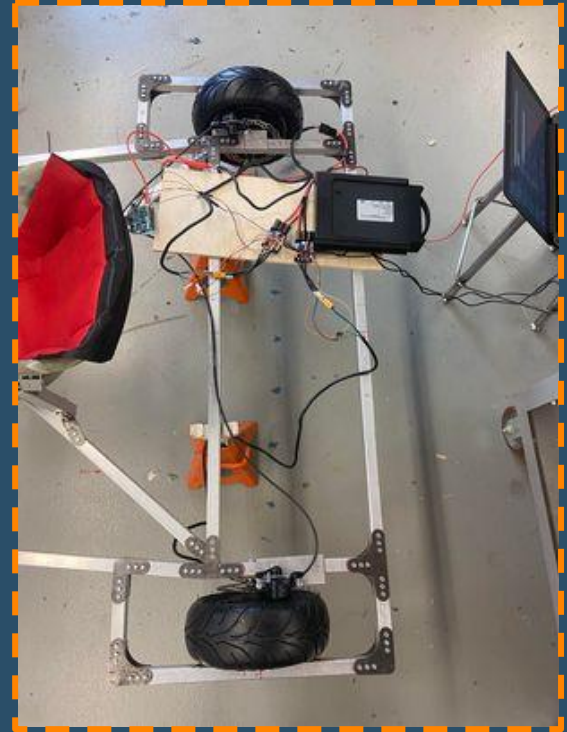


Results and Discussion

Mostly successful!

Things we would do differently:

- Weld together the frame instead of utilizing brackets and bolts
- Spend more time researching electrical components
 - Cross-reference other projects with similar components
- Improve rear wheel connection





SUCCESSSES



06

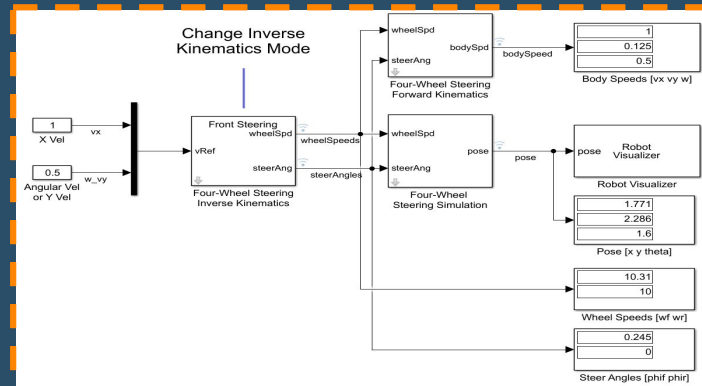
Future Research





Implementing Four-Wheel Steering

- Simulating four-wheel steering in MATLAB
 - Better use of the Kalman Filter
- Go-kart model
- Steering simulations
 - Not based on actual data



```

wheelRadius = 0.1; % Wheel radius [m]
wheelDists = [0.3, 0.25]; % Front and rear wheel distances to CG [m]
vehicle = FourWheelSteering(wheelRadius,wheelDists);

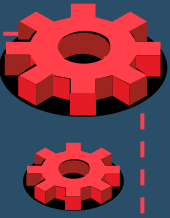
%Front wheel Steer
wheelSpd = [1; 1]; % Wheel speeds [wf; wr]
steerAng = [pi/4; 0]; % Steer angles [phif; phir]
vel = forwardKinematics(vehicle,wheelSpd,steerAng);

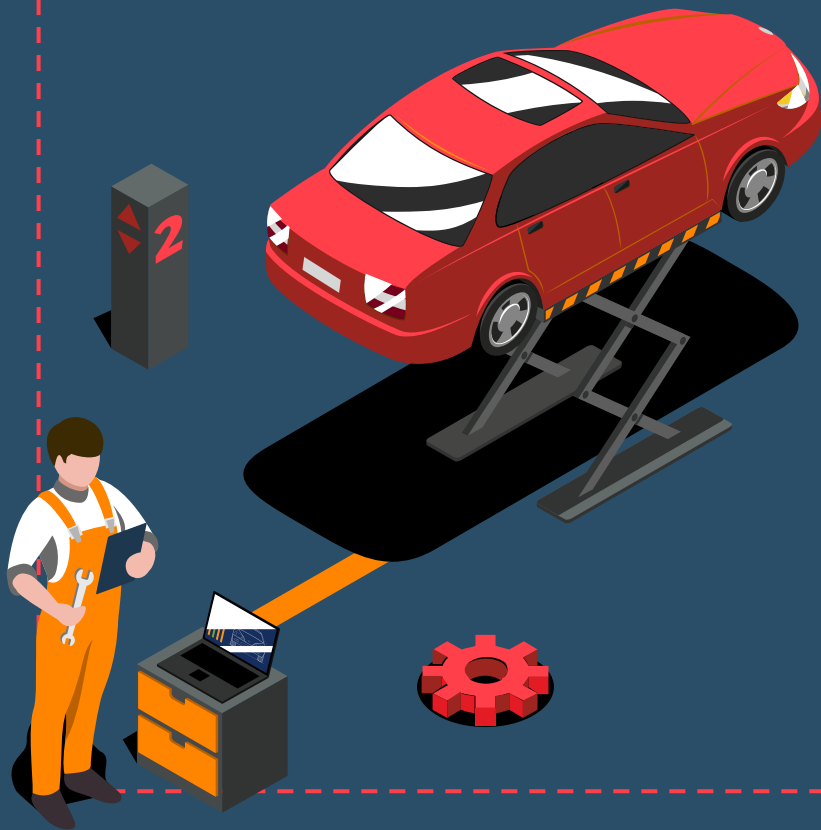
%Turn without turn
vx = 0.5; % Forward speed [m/s]
w = 1; % Angular velocity [rad/s]
[wheelSpdFS,steerAngFS] = inverseKinematicsFrontSteer(vehicle,vx,w);

%Parallel
vx = 1; % Forward speed [m/s]
vy = 0.3; % Lateral speed [m/s]
[wheelSpdPS,steerAngPS] = inverseKinematicsParallelSteer(vehicle,vx,vy);
  
```

Acknowledgements

- Lab Directors:
 - Mr. Clinton Behling
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 - Dr. Daniel Parilla
 - Mr. Jared Seyler
- Our parents
- Sebastian Toro





Thanks!



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