NFPA Fluid Power VEHICLE Challenge

NFPA Education and Technology Foundation

FINAL PRESENTATION
University of Alabama at Birmingham
Dr. David Littlefield
4/21/2022

Team Introductions

- Team 1: Natasha Wright, Zi Song, Zongtan Sun, and Ziyu Liu




- Team 2: Zack Tucker, Dustin Brubeck, Alex Schimmer, and David Smith




Hydraulic Bike project review

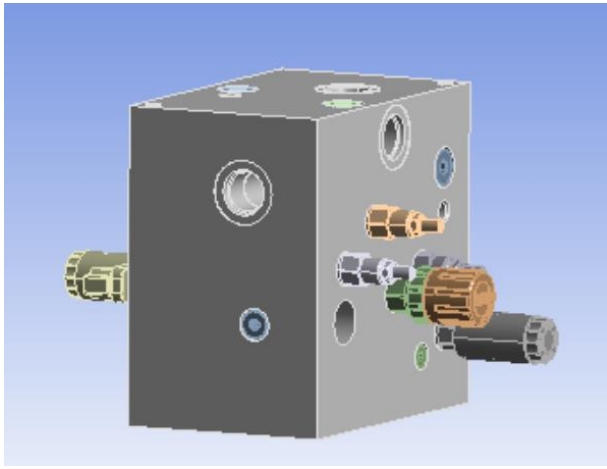
Problem Statement:

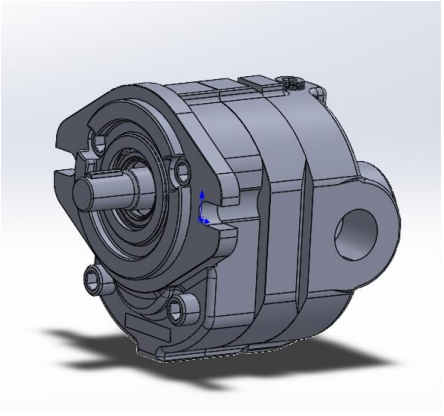
- Build and manufacture a vehicle that is powered solely by hydraulic power and that is designed to meet design and safety requirements and competition restrictions.

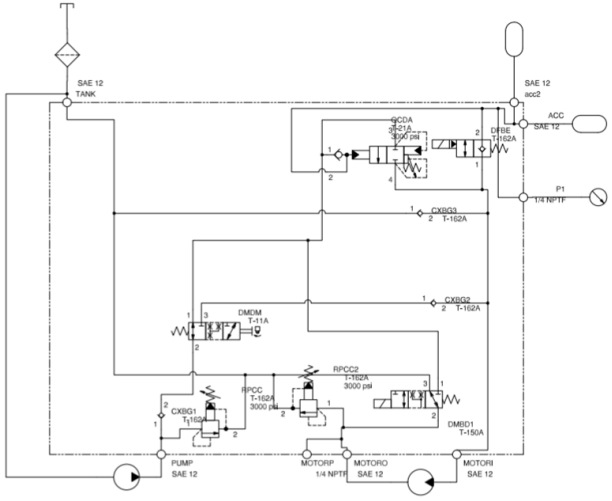
Objectives:

- Achieve propulsion through a hydraulic system with human input as the work input.
- Include multiple brakes capable of stopping both the vehicle and the rider
- Include a pressure gauge between the accumulator port and any other valve in the system.
- Don’t exceed the maximum combined volume (1 gallon) for any accumulators.
- Design the vehicle to be less than 210 lbs.
- Be the first UAB team to compete in the Fluid Power Vehicle Challenge

Midway Presentation Summary
Vehicle Design

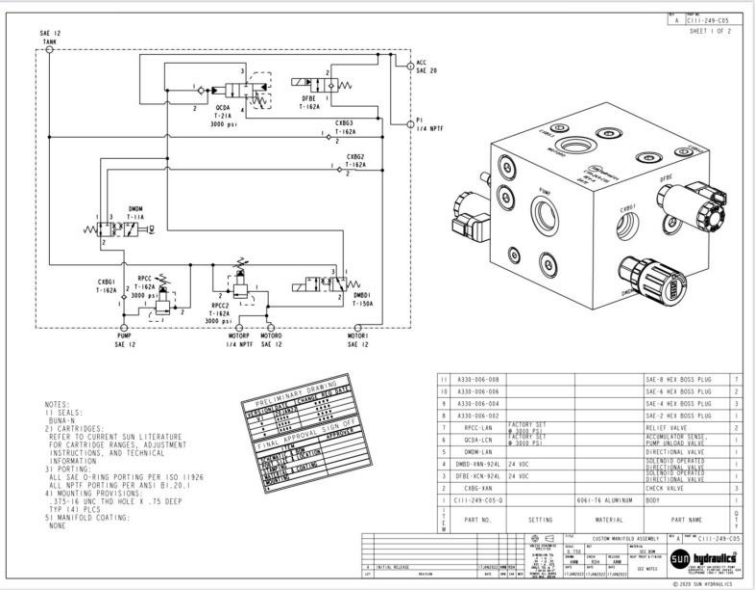


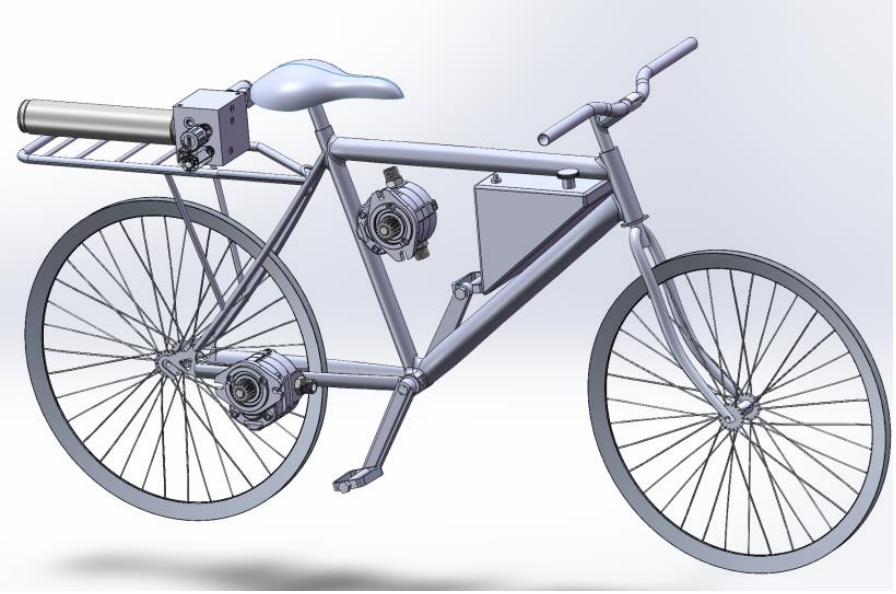




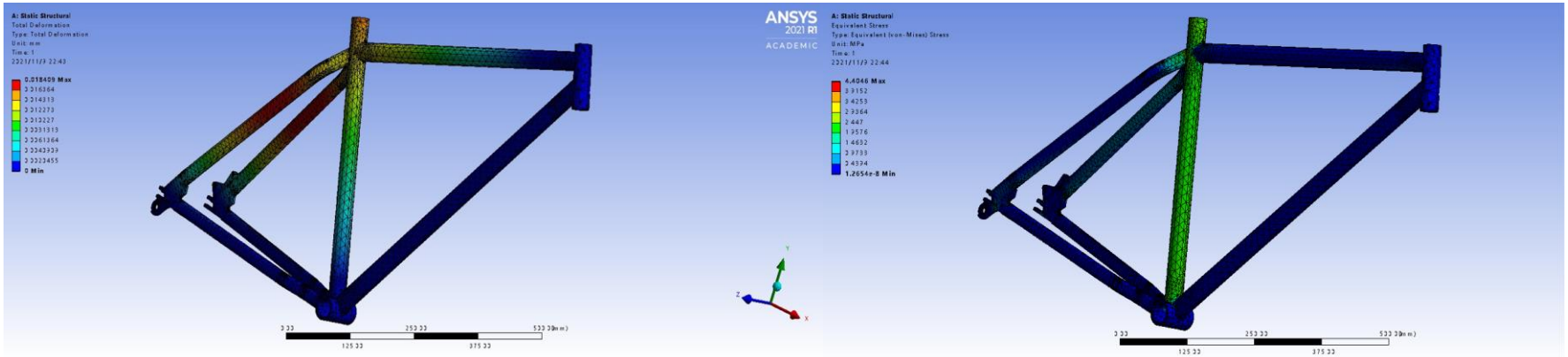
Midway Presentation Summary

Fluid Power Circuit Design





Results and Analysis



Vehicle Construction

Custom hydraulic tank and rear rack

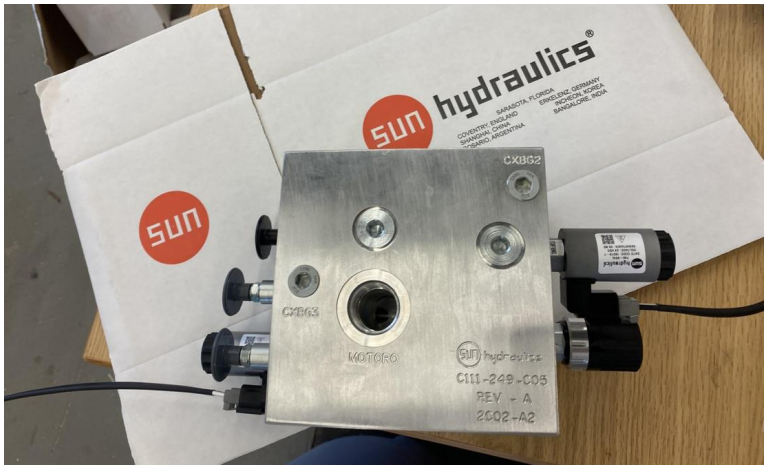
Vehicle Construction

Motor Mounting

Pump Mounting

Vehicle Construction

- Accumulator and manifold
- Hydraulic hoses
- Switches



Vehicle Testing

- Ensured that switches relayed to the solenoid directional control values
- No individual components were tested (Caused major delays)
- Hydraulic reservoir leak test
  - 1st reservoir did not pass leak test and had to be refabricated
- System testing with fluid to check that the bike functioned as designed

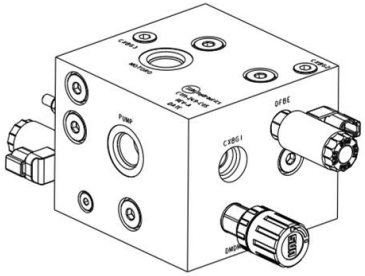
Final Vehicle Design

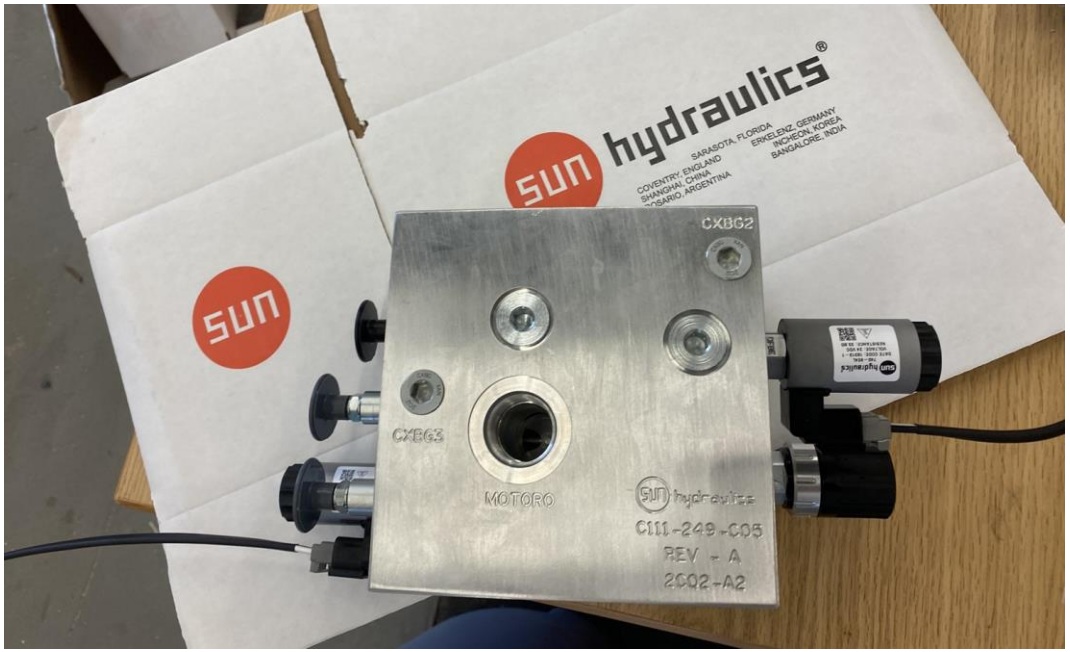
Main Components:

- Hydraulic Manifold
- Accumulator
- Pump
- Motor
- Battery & wires
- Tank
- Hoses & fittings
- Bike frame and rack

Final Design: Manifold

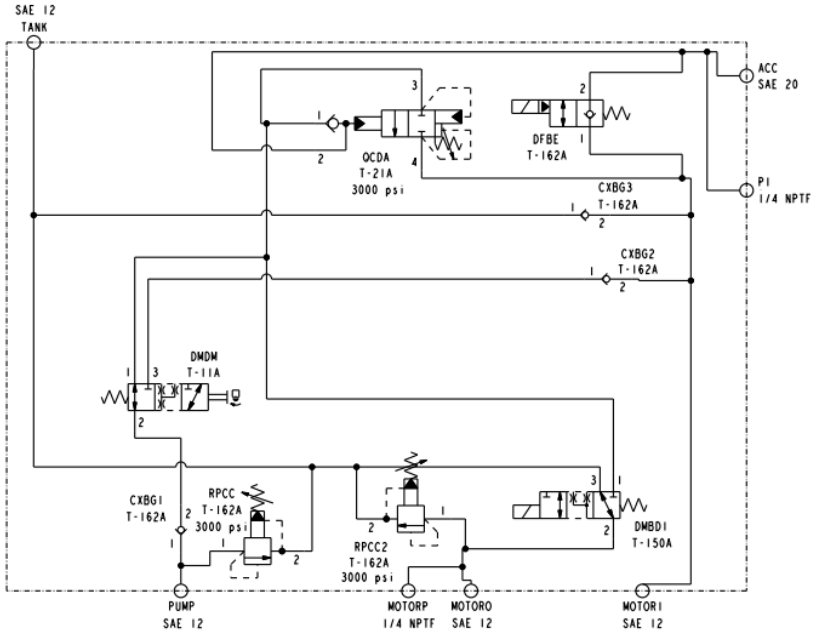
- Includes a relief valve, accumulator unloading valve, two solenoid operated directional valves, and check valve to control our system
- Four main external ports and two ports for pressure gauges (Accumulator and motor output pressure for safety measures)
- Brain of the hydraulic system





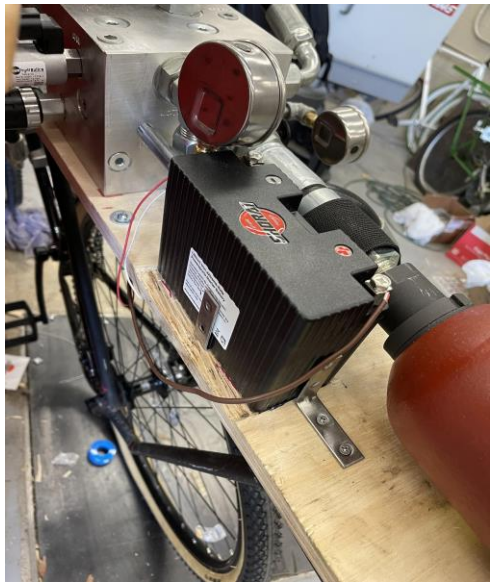
Final Design: Hoses and Circuit

- Hose Selection: Hydraulic Constant Working Pressure Hose **4000 PSI** - GlobalCore 487 Hose | #487TC-12
- Hose Inside Diameter: 3/4 inch, 19 mm



Final Design: Regenerative Braking

- Circuit design of valve control switch in manifold. The wire is inside the frame instead of transmission wire.
- Left hand side: accumulator pressure release switch
- Right hand side: regenerative braking mode switch



Final Design: Tank

Final Design: Pump and Motor

Final Design: Accumulator

The accumulator is a quarter gallon capacity due to supply chain issues, the company we used was not be able to ship us the one gallon piston accumulator in time.

An adapter was needed to connect it to the manifold due to manifold design using one gallon piston accumulator port size.

Lessons Learned

- Hydraulic circuit design
- Component bench testing would have decreased delays in system testing
- NPT vs. ORB fittings
- Hydraulic tank design failure → 1st tank leaked
- Optimal sizings of hydraulic pump, motor, and hoses (ours are oversized as designed)

Video Submission

Thank you!

Any questions?