FLUID POWER VEHICLE CHALLENGE: FRAME DESIGN

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Abstract

The Fluid Powered Vehicle Competition (FPVC) is an intriguing design and build competition that involves the integration of human power and fluid power (hydraulics) into one vehicle. The FPVC is arranged by the National Fluid Power Association (NFPA), involving many universities. The NFPA appoints judges to rank each team on different criteria. The biggest challenge to overcome in the design was the implementation of a fluid link as a power transmission method.

Introduction

The main objective of the competition is creating a vehicle that does not use direct electrical or mechanical power, but using hydraulic power through a pump, motor, and accumulator. The teams are required to use pneumatics, regenerative braking within the hydraulic system, as well as a recommendation of the use of electronics. As a result of these various requirements, the frame designed for the vehicle must be both lightweight, as well as strong and ergonomic to be capable of integrating all of these various systems into one package efficiently.

Methods and Materials

To adhere to a weight limit restriction of 210 lbs., it was imperative to use a material with high stress resistance, and low material density. Reinforced Carbon fiber tubing was selected because of its Performance Index of 72.8. This provides a higher strength than many metal alloys, while being more lightweight. Carbon fiber has a tendency to tear and crack when the weave is disrupted, so a non-intrusive method of connecting the tubing was necessary. This was accomplished with CARBONNect® connectors from Rockwest Composites.

FEA Analysis

- Maximum deformation of 0.053439in (1.36mm)
- Maximum Von Mises Stress of 21450 psi (147.89 MPa)

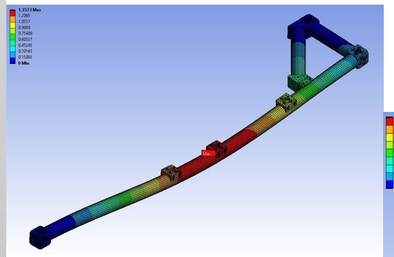

Figure 1. Total Deformation

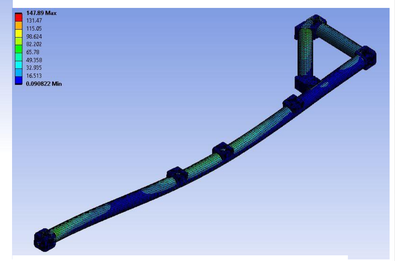

Figure 2. Equivalent (Von-Mises) Stress

Results and Discussion

The frame prototype of the fluid-powered recumbent tricycle is designed to be lightweight and structurally sound holding the rider and all the various components. The frame is rigid and is capable of holding up a significant load.

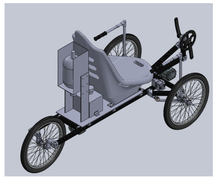

Figure 3. CAD Isometric View

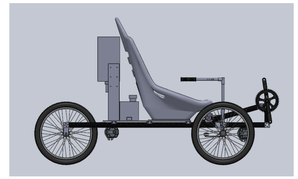

Figure 4. CAD Side View

Conclusions

The frame prototype for the fluid-powered recumbent tricycle is an original design. The originality of the frame and the mounting components gives this tricycle an edge in the FPVC competition where a majority of the FPVC teams use pre-manufactured frames and parts. The end goal of creating a lightweight and rigid frame is attained.

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