Human Powered Hydraulic Bicycle

Team Members:

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Department of Agricultural and Biological Engineering

Senior Capstone Design

CHAINLESS CHALLENGE

Mission Statement

To design a hydraulic bicycle that will meet the specifications required to compete in Parker Hannifin's Chainless Challenge.

Competition Rules and Guidelines

- No chains are allowed. Final method of propulsion must be hydraulic.
- Allowance of one year to complete the design and build the bicycle.
- Type of bicycle used is chosen by team.
- Safety is a main concern. Each rider must provide his/her own protective wear.

Project Objectives

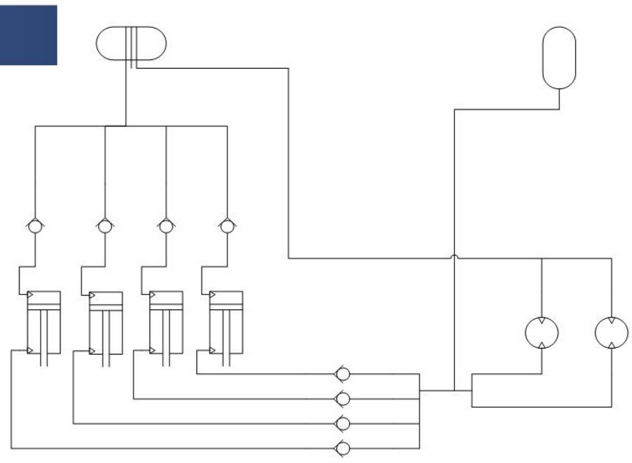
- To conceptualize and formulate a design plan
- To build a safe and working bicycle
- Allow time for testing on completed bicycle
- Perform well in final competition

Design Procedure

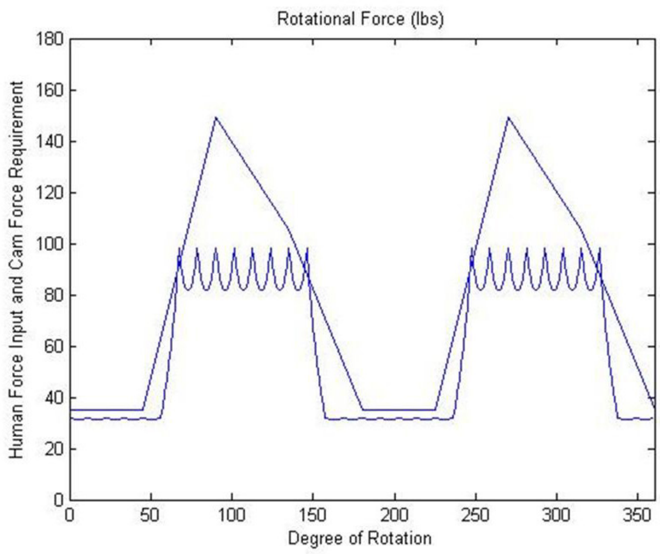
- Model effective hydraulic circuit
  - Pneumatic components will be used to reduce weight
  - A four stroke system on the pedals running to motors powering the rear wheel
  - Air will be used for the sprint race and water will be used for the long distance race
- Modify bike to work with hydraulic circuit
  - Brackets will be added to the bicycle to hold all components to the frame
  - All sprockets and chains were removed
- Test completed bicycle
  - Tests will performed to check for errors, leaks, and performance
  - All problems will be fixed before the race

Hydraulic Circuit

An air tank was chosen to be used for the sprint race to provide faster speeds over the short distance of 300 yards. This tank will bypass the cylinders and be connected straight to the motors. Only one motor will need to be used in this race due to the downhill nature of the course. A valve will be used to allow adjustable flow from the air tank.

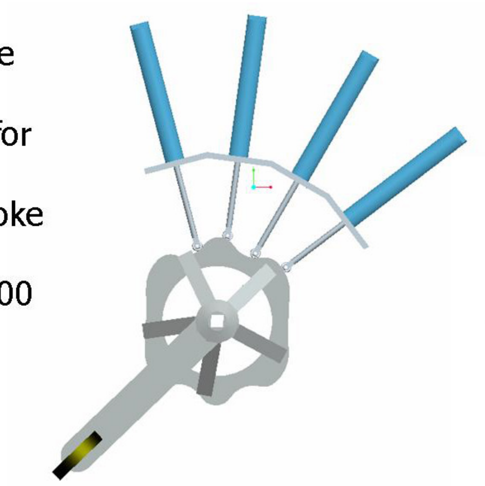


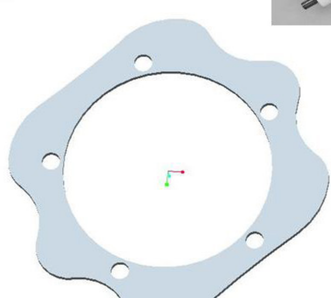
Hydraulic Components



Using Matlab, a graph was made to compare the force output by a rider on the pedals vs. the force needed by the cylinders at that position. This allowed for a four stroke system to be chosen. It also allowed for decisions to be made about the shape of the cam to be used. As seen, when the pedals are at 0 and 180 degrees there is very little force output by the rider; therefore, the cam was modified to accommodate for this.

An 6-lobed cam in place of the original bicycle sprockets was chosen for the cylinders to follow. This produced a 24 stroke per revolution system providing 1.4 gpm at 100 psi.





Two motors were chosen to power the rear wheel. Each will be used separately and controlled by a valve that switches the flow to the desired motor. It was necessary to use two due to the elevation changes on the course; therefore, the motors serve as a gear reduction. They will be attached to the rear wheel directly to increase efficiency. Training wheels will be used to ensure safety of the motors in case the bicycle tips over.

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Hydraulic Bicycle Team
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April 2007

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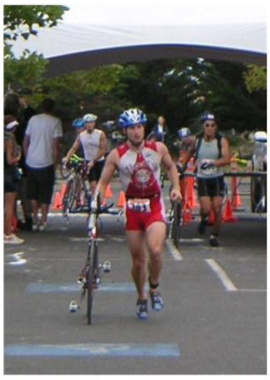
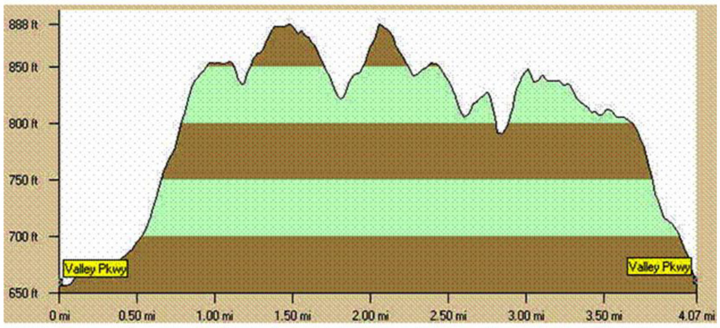


Course Elevation Changes

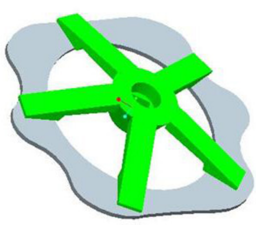
The race rules state that any team that is able to complete the course without getting off the bicycle and walking it automatically wins. As seen in the graph, the elevations changes are quite drastic, and doing so will be very difficult.



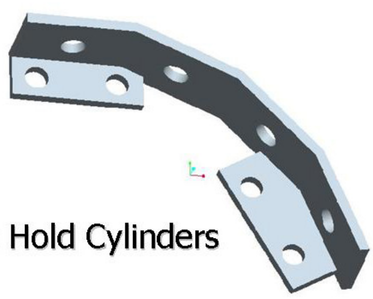
Analysis

Pro/Engineer was utilized to model the bicycle effectively. Using the software allowed the team to visualize the finished bicycle before physically building it. It also allowed the team to model the cam and use the program with a CNC machine to cut it accurately.

Cam on Pedal Mount



Bracket to Hold Cylinders



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