Low Cost Rockshaft Position Control

Overview

The problem that John Deere presented was that the rockshaft system of their 1 Series tractor uses a mechanical control that is expensive to manufacture. They wanted us to develop a way to replace this mechanical control with a cheaper electrical one. They recommended the use of solenoids controlled by pulse width modulation.

Objectives

Our team’s objective was to lower the cost of manufacturing the Rockshaft by replacing the mechanical linkage with a solenoid valve that is electrically controlled. Our design of the Rockshaft must still operate at an equal level of performance as the mechanical system, and be able to lift up to 500 pounds.

Approach

- Had an initial conference call with John Deere to obtain project requirements and specifications
- Held weekly meetings with our sponsor to ask questions, receive feedback, and stay up to date
- Reviewed CAD Models of the Rockshaft provided by John Deere
- Researched hydraulic components to closely match that of the 1 Series John Deere tractor
- Designed a test stand in SolidWorks capable of supporting the Rockshaft and hydraulic system
- Built the test stand to support the prototype
- Performed benchmark testing of the mechanical system to later compare with the performance of our electrical prototype
- Designed a circuit to communicate between the controller and the solenoid valves
- Tested the circuit in Multisim and with LEDs before implementing
- Removed the mechanical linkage and replaced it with a double action solenoid
- Integrated the solenoids into the circuit and attached to the Rockshaft (completing the prototype)
- Repeated the testing procedures and compared the results with those from the benchmark testing

Outcomes

- Proved the feasibility of using electrically controlled solenoids to operate the Rockshaft
- This project reduces the cost of manufacturing the Rockshaft by 20%
The prototype is robust enough to lift 700 pounds, an amount well over the original requirement.