Design and Control of Four Independently Metering Proportional Control Valves

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Abstract

The concept of this project is to simulate a hydraulic system that utilizes a system of four individual valves to perform various functions and then correlate the data to a physical valve on a hydraulic test stand. The process first involved obtaining a donated valve, understanding the mechanics and hardware, and then recreating the valve in a Simulink environment.

Methods and Materials

Multi-Purpose Yuken Valve

- Functions as a four position 4-way valve
- Potential for regenerative circuit at position #3

Simscape Remodeling of Yuken Valve for Bucket Arm Actuation/Tilt

The Yuken valve’s hydraulic schematic and mechanics were recreated within the MATHWORKS Simscape platform. The operation of the valve involves two solenoid-operated control valves that direct pilot pressures to open/close a set of four check (poppet) valves.

Once the valve was finalized, a complete hydraulic system simulation was built around it to tilt a bucket arm.

Discussion / Results

Various plots and data points can be collected by running the Simscape simulation.

Conclusions

Simulation of the Yuken valve mechanics is functional. However, arbitrary values for some of the valve parameters were used for initial runs. This issue can be addressed through future hardware testing and communication with the valve manufacturer. Then when parameters are updated, correlation between the test stand and simulation data can proceed.

The current tools, mechanisms, and simulation schematics will provide a strong foundation for future design.

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