

Automated Seal Pump Testing and Leakage Detection

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Abstract

The objective of this project is to design and produce a device that can do automate pump testing and leakage detection. The Robotic Injection Pump Tester or RIPT includes an Arduino microcontroller, a fishman fluid dispenser, stepper motor with motor control and driver. RIPT has the capability to mimic the way that a technician (Terry) performs a pump testing. RIPT will obtain information accurately and increase the consistency in pump testing while reducing technician workload. LAD or Leakage Automated Detection is comprised of a web camera and a Raspberry Pi kit. LAD is designed to have the capability of detecting the exact moment when a seal fails by capturing the live image of fluid leaking from a dynamic or round static seal and can classify the type of leakage.

Introduction



Currently SKF's technicians perform labor intensive pump testing and face number of challenges when observing the exact moment that a dynamic seal begins to fail at performing its primary function. Currently there is no commercially available technology to detect when dynamic or static seals fail. A technician must look at the seal or fluid levels need to be checked to know if fluid is leaking. The Pump test shows the pumping rates of dynamic seals, or how fast the seal can move the fluid from the dry side to the wet side. Both are done by technicians and can be time consuming. SKF has been developing an autonomous test for since last school year. The project for the NIU students this year is to further develop the current prototype concept or to redesign the autonomous pump test to a usable prototype. This project could include autonomous leakage observation.

Methods and Materials

Leakage Detection

The Leakage Detection project consists of a Raspberry Pi 4, Pi camera, a touchscreen interface, python GUI and cooling system. The Raspberry Pi 4 is used as the computer to run the python GUI used to detect the leaks, and to send the data sheets to the technicians. The Pi camera can be placed on a multitude of machines as long it has at least two inches of clearance from the dynamic seal. The team then designed a custom case for the Pi system to allow extra cooling due to the heat that it was producing. The system allows the technician to enter in data specific to the test performed, then tracks the seal with the camera until a leak is detected. After the first detection data is then imputed into an excel sheet and continues to track the leak till a specific end condition is met.



Automatic Pump Test

The Pump test consists of the Fishman LDAV automatic dispenser unit, python GUI, Oriental stepper motor, programmable motor controller, and an Arduino. The Arduino is used as a controller to send signals between the python GUI and the Fishman LDAV. The Fishman LDAV is programmed to run specific fluid dispensing programs based on the amount of fluid needed, without drippage and precision to 20 μ L. The stepper motor is used to place the dispenser at the lip of the seal and move the dispenser out of the testing area due to the heat produced by the testing machine. The whole program is controlled by a python GUI.



Results/Discussion

The team found that the LAD system can perform the tests required from saved videos on laptops. RIPT will be able to perform the Pump test motion over the seal over 20 times without the need of interference of the team. The camera system was able to track a fluid within the first 0.3 seconds that it was present, which is on par with the current technician. The team was unable to test on the VRM at SKF at the time of this report.

Conclusions

The team was successful in the design and building of both the LAD and the RIPT and recommend testing of both systems. Updates to the platforms include the use of an encoder for the stepper motor, a larger Arduino to act as a controller to the Fishman, and a case study on the Fishman LDAV limitations. However, the system is efficient at tracking the fluids and further testing needs to be done to compare the autonomous systems to the current methods.

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