EML 4551C – Senior Design – Fall, 2012 Deliverable

Team 5

Needs Assessments

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Need Assessment

The purpose of this project is to build a sensor ring testing rig. Currently, to test the sensor ring, it is placed on the testing platform and is adjusted by hand. This process takes a great amount of time and effort. Turbocor wants a new method to test a large quantity of sensors in a short amount of time. To achieve this, a fully-automated process must be implemented to control the sensor while it is on the platform. The platform needs to be able to test three axis displacements in the X, Y, And Z directions. A high level of precision is required since the displacement is limited to 2 micrometers. The new design must have zero back-lash, be fully-automated, and be able test a sensor repeatedly.

Problem Statement

Turbocor is currently using a sensor testing platform that required an assembly worker to place a sensor ring on to test. Software acquires the data and determines if the sensors pass or fail for use in a compressor. The existing mechanism that displaces the sensors ring have backlash and is unsuitable. The problems arise as the platform continuously needs to be calibrated after a certain amount of sensors are tested. In order to improve efficiency, a system which automatically tests the sensor is needed. The platform must be able to be highly accurate because the required error is only about 2 micrometers.

Justification and Background

Turbocor has a current system for testing shaft sensor error that needs to be improved. A current system for testing does not produce a required accuracy. If the required accuracy of the

sensor is not met, the senor cannot be used in the final product. Backlash is a major issue that needs to be overcome to achieve accuracy.

The system in use now utilizes a spring system that locks the sensor ring into place. This sensor ring surrounds the test shaft. This shaft is mounted "off center", thus creating a displacement that can be measured by the sensor. If the known displacement does not match the displacement read by the senor, the senor does not pass testing. The problem with this method is that it does not yield an error in measurement that is acceptable.

A previous system used was more accurate, yet required much manual adjustment. This design was able to track the position of the sensor ring in a relation to the shaft using the concept of a micrometer. This created good accuracy. However, the sensor ring had to be rotated 90 degrees to switch from sensing the X direction to the Y direction. The initial position of the sensor also had to be slowly calibrated using a micrometer- screw system. This process is slow and requires more manual interaction than desired.

A new sensor test rig design is required that can be quickly calibrated and yet maintains a low margin of error.

Objective

The main focus of the active research and development at Turbocor aims to improve the testing process of the sensor rings. The goal of the project is to design a system that can automatically and precisely test the proximity detection error of the sensor rings. We aim to design and develop, during two semesters, a test rig capable of moving a prescribed displacement in the X, Y, and Z directions, as well as fully automating the testing process while maintaining

extremely high precision. By upgrading and implementing the testing rig, testing time and reliability will improve leading to greater performance of the Turbocor machines.

Methodology

In order to achieve a low margin of error in testing with quick operation and adjustment, we must first research precision motion devices. This may yield examples of designs used for similar types of motion devices.

The first objective of accuracy and ability to calibrate will be judged by determining the error in measurement of the displacement of the shaft in the X, Y, and Z directions of a Cartesian coordinate system. Furthermore, ease of loading and testing the senor ring will be assessed. The system will ideally be automated to test X, Y, and Z measurement error with minimal manual user interaction. In addition, a prototype of our design will be produced to be tested and analyzed.

Expected Results

Upon the completion of this Senior Design Project, the sensor test rig has to test the sensor rings in a very accurate manner. The sensor will be placed around a shaft that will then rotate and the sensor will be able to measure the distance away from the ring in three spatial directions. The rig has to be able to move within micrometers and with zero-backlash. After the design process has been completed Turbocor will supply all the materials required and manufacture any necessary parts.

Constraints

Turbocor has planned to provide all the materials and machining needed for the Senior Design Project. With this limit removed the only constraints are design constraints and those associated with the senior design course. The sensor test rig has to be able to move spatially in the X, Y, and Z direction with absolutely no backlash. The test rig ideally would be the same size or smaller than the previous sensor test models. It should not require a manual input for the movement in the X, Y, and Z movement; as such it should be autonomous. The project has to be completed within the two semesters during the 2012-2013 year. Certain milestones have to be met during that period.