Project Report

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Date: February 2025

# Abstract

This project focuses on creating automation to check lifespan of worm gearbox. Gearboxes are critical components in various industrial and mechanical systems, playing a vital role in power transmission. Ensuring their reliability and longevity is essential for minimizing downtime and maintenance costs. Traditional methods of lifespan assessment rely heavily on manual inspection and periodic testing, which can be time-consuming, error-prone, and insufficient to detect early signs of wear. This study introduces an automated system for evaluating the life span of gearboxes using advanced sensing technologies, machine learning, and real-time monitoring. The system incorporates sensors to measure key parameters such as vibration, temperature, torque, and rotational speed.

# Introduction

The most important criteria for the design of a gearbox is a sufficient strength of all components. There are, however, different ways to define this demand. The two most common ones are either defining minimum required safety factors for a given lifetime or prescribing a minimum likelihood to achieve a certain lifetime, often expressed in the reliability of a component within a given lifetime. This paper discusses the different approaches and the relationship between the safety factors and the calculation of the reliabilities.

Objectives

* Factors that affect lifespan
* Causes of early failure
* Vibration measurement
* Automated design

# Methodology

The easiest parameter to measure would be the number of gear change, the load and the temperature. It is clear that no one reads them and therefore it cannot be used. Therefore, generalized mileage and kilometres are used, taking into account the average user.

# Components Used

* Electronic counter (XC410)
* Inductive Proximity Sensor
* SMPS (Switch Mode Power Supply)
* Battery
* Motor
* DPDT Relay
* Limit Switch

# Working Principle

The system controls the direction of the motor and monitors the gearbox cycles using a combination of a DPDT relay, limit switches, and a proximity sensor. The DPDT relay is responsible for switching the current direction to rotate the motor either forward or reverse, based on signals from two limit switches. When a limit switch is triggered, the relay changes the motor's direction accordingly. The gearbox’s movement is tracked by an inductive proximity sensor, which detects when the gearbox completes a cycle. The proximity sensor is connected to a counter device (XC401B), which logs the number of completed cycles. Limit switches are mounted with a flap on the gearbox that activates the switches when the gearbox reaches its full motion, switching the direction. This setup enables automated motor control and cycle counting for effective monitoring of the gearbox's lifespan.

# Results & Observations

The calculation of reversal stress reveals that rapid direction changes significantly impact the gearbox. As the time for reversal decreases, the stress on the system increases, which is particularly critical in high-power applications such as servo motors and wind turbines. The results emphasize the need for careful management of these stresses to prevent system failure. Incorporating electronics for real-time monitoring in next-generation gearboxes will help detect loading issues early, preventing catastrophic failures and ensuring the longevity and reliability of mechanical systems.

# Conclusion

This project successfully demonstrated the automated control of motor direction and cycle monitoring using a relay system, limit switches, and a proximity sensor. The system effectively manages the gearbox’s operational cycles, ensuring its longevity and preventing premature failure. By integrating electronics for real-time monitoring, next-generation gearboxes can better manage stresses, especially during reversal, and detect potential issues early. This approach will enhance the reliability and lifespan of mechanical systems in various applications, from machinery to wind turbines, highlighting the importance of proactive maintenance and condition monitoring in modern engineering systems.

# References

1. ANSI/AGMA 6013--A06 Reaffirmed April 2011, “American National Standard for Industrial Enclosed Gear Drives”, 2011
2. Erwin V. Zaretsky, “Rolling Bearing Life Prediction, Theory, and Application”, NASA Center for

Aerospace Information 7115 Standard Drive Hanover, MD 21076–1320, 2013

1. Tedric A Harris, “Rolling Bearing Analysis”, A Wiley-interscience publication, 2007
2. ABMA STD 9, “Load Ratings And Fatigue Life For Ball Bearings”, 2015 and ABMA STD 11, “Load Ratings and Fatigue Life for Roller Bearings”