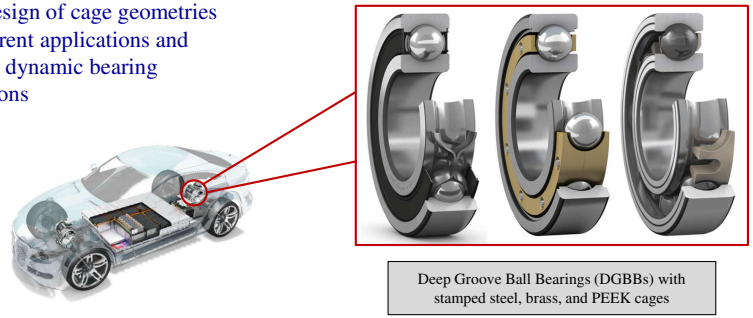
Motivation & Background

- Deep groove ball bearings are popular in various industrial applications and are able to operate at high speeds, including electric motors
- Bearing cage failures are a common issue in rolling element bearings leading to catastrophic bearing failure and machinery it serves
- Inadequate lubrication can lead to increased friction and heat, which can accelerate wear and deterioration of the cage material.
- Understanding the mechanism of cage friction & lubrication can aid in the design of cage geometries for different applications and improve dynamic bearing simulations



Deep Groove Ball Bearings (DGBBs) with stamped steel, brass, and PEEK cages

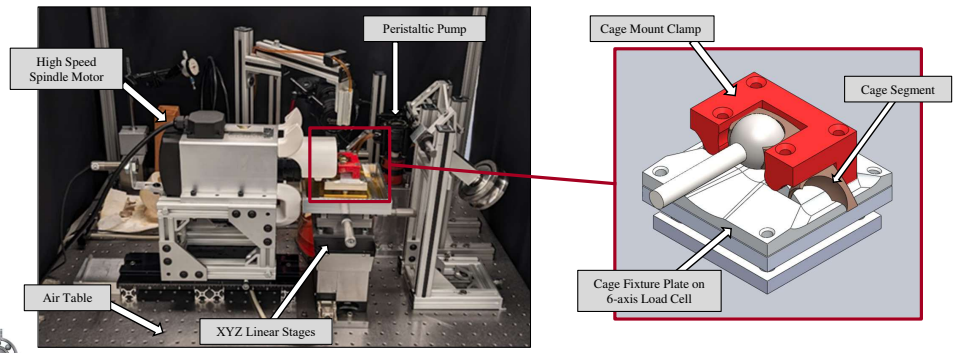
Objectives

The objectives of this investigation are:

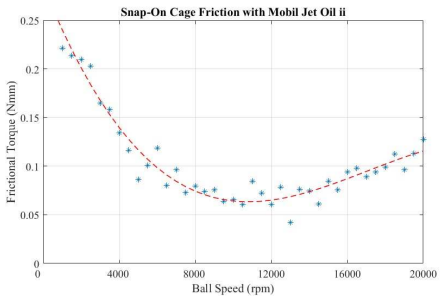
- To experimentally examine the oil flow inside the cage pocket of a deep groove ball bearing (DGBB)
- To identify the effect of oil supply at higher ball rotation speeds by quantifying the cage frictional torque using various cage geometries
- Continuously upgrade the BCFTR so that oil supply to the cage pocket is sufficient on the test rig, while also simulating a real bearing used in practice

Bearing Cage Friction Test Rig

- Bearing Cage Friction Test Rig (BCFTR) enables visualization of oil flow within bearing cage pocket and measures cage frictional torque
  - Cage can be positioned inside pocket relative to ball
  - Range of ball speeds (0 - 24,000 rpm) supplied by spindle motor
  - Capable of delivering different viscosity oils at various flow rates using a peristaltic pump
- Cage segments are mounted around the ball on a high precision 6-axis load cell
  - The entire cage assembly and sensor are mounted on XYZ linear stages



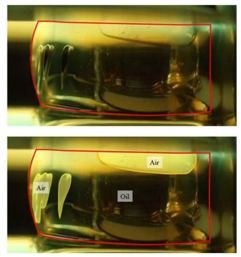
Frictional Torque and Lubrication



BCFTR Measured Cage Friction Torque Results

- Cage frictional torque decreases with speed since less oil is supplied to cage pocket
  - Oil delivery to cage pocket at higher speeds is important in simulating a bearing used in practice

- The BCFTR is capable of running transparent cages for oil flow visualization



Oil Starvation in Cage Pocket Using Transparent Cage

Various Cage Segments Used On BCFTR