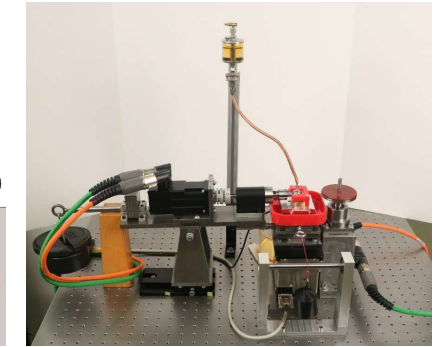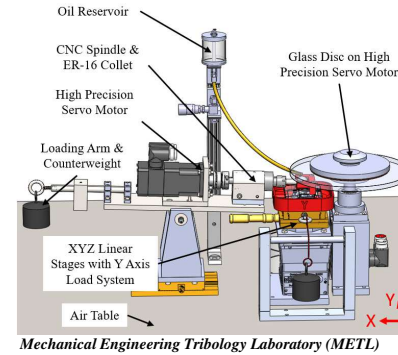# Objective of Research

- To conduct fundamental research on the behavior of high-speed ball bearings to develop a Condition-Based Monitoring (CbM) system.
- Using CAE to fabricate a multi-physical regime, we anticipate analyzing the behavior of rolling elements and subcomponents at high-speed operating condition, creating a comprehensive database through parameter studies and experiments.

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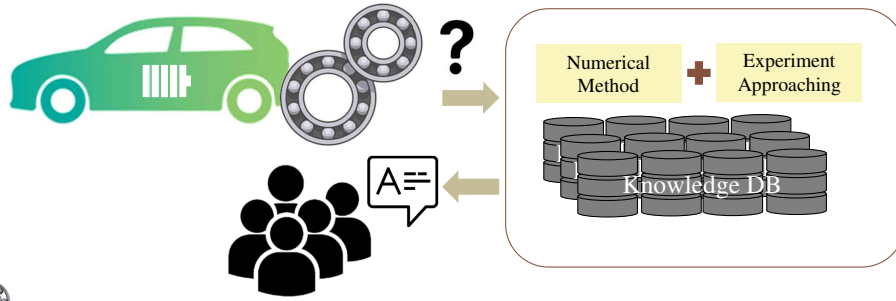
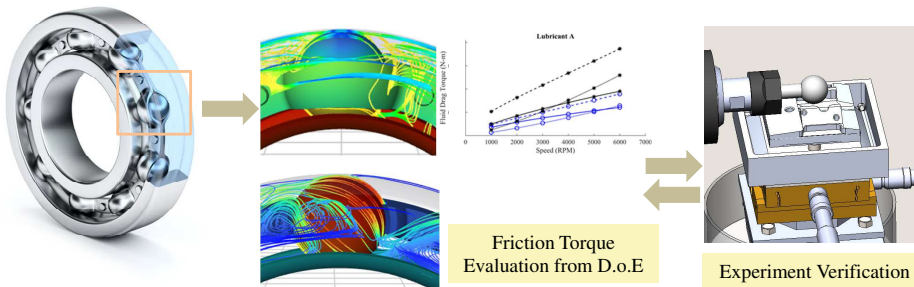# Bearing Cage Friction Test Rig (BCFTR)

- Based on a classic optical EHD rig design with a ball rolling on the underside of a glass disc
  - Two servo motors independently control the motion of the ball and the disc
  - Lubricant is delivered directly onto the rotating ball using a oil reservoir with a flow adjustment valve
- Cage segments are mounted around the ball on a high precision 6 axis load cell
  (Force and Torque in X, Y, and Z axis)
  - The entire cage/sensor assembly is mounted on XYZ linear stages
  - The ball / cage contact is preloaded in the Y direction with a dead weight loading system

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Cage Friction Torque Investigation
CFD and BCFTR

Application

Friction Torque Evaluation from D.o.E

Experiment Verification

Objective: Research of Computer Fluid Dynamics (CFD) model to examine the relationship between oil flow and cage design factors, specifically focusing on the cage friction torque

- Conduct D.O.E. (Design of Experiment) for cage topology using CFD
- BCFTR Experimental results were corroborated with a single-phase CFD model
- Derive the fuel efficiency cage design and generalize the relationship between cage torque and topology (pocket clearance, cage thickness, cage pocket shape on snap-on type)
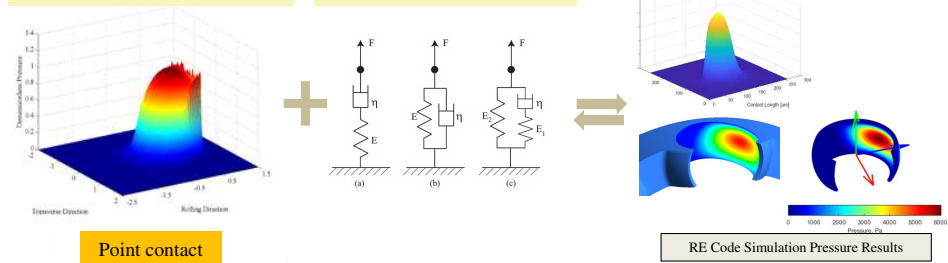
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Soft EHL Development on Polymer Cage
Analysis concept of Soft EHL

Hard EHL (Metal to Metal)

Viscoelastic Model

Point contact

RE Code Simulation Pressure Results

Objective: Investigation of Hydrodynamic Cage Lubrication to predict abnormal contact between cage and ball using Soft EHL

- Development EHL model to replicate viscoelastic behavior of polymer cage
  - Numerical model as following up previous research in METL
  - Support to verify FSI and RE code
- Verify numerical model from experimental results of EHD2 test rig
- Predict reliability of cage in regard to abnormal contact (concerning cage-slip in rolling elements)

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