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Thin Layer Flow in Rolling Element Bearings

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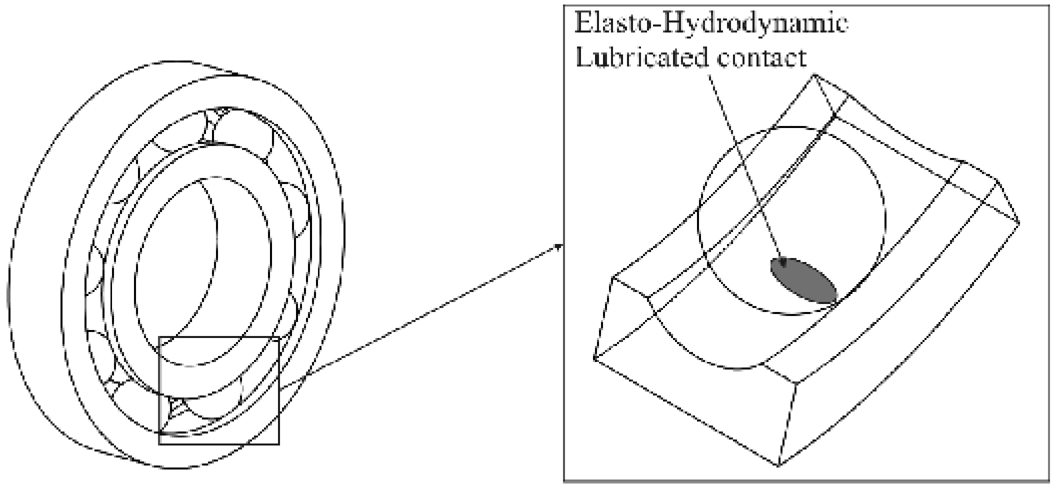
Introduction

<u>Background:</u>

- Rolling element bearing: *Service life??*

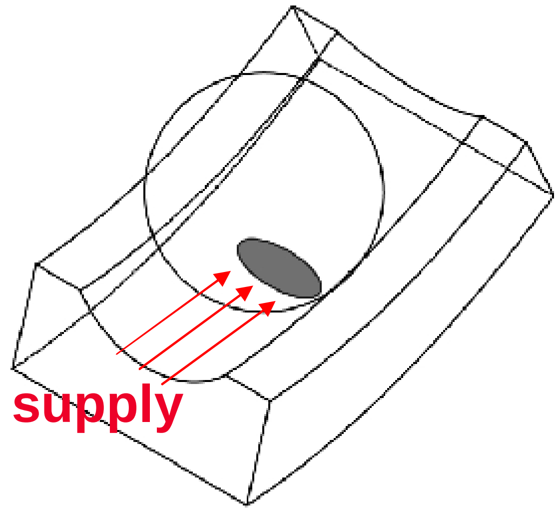
- <u>Greased and sealed for life:</u>
  Service life is determined by *grease life*.

- *Grease life:* Maintain a sufficiently thick lubricant film.



Introduction

Supply layer thickness ó Film thickness

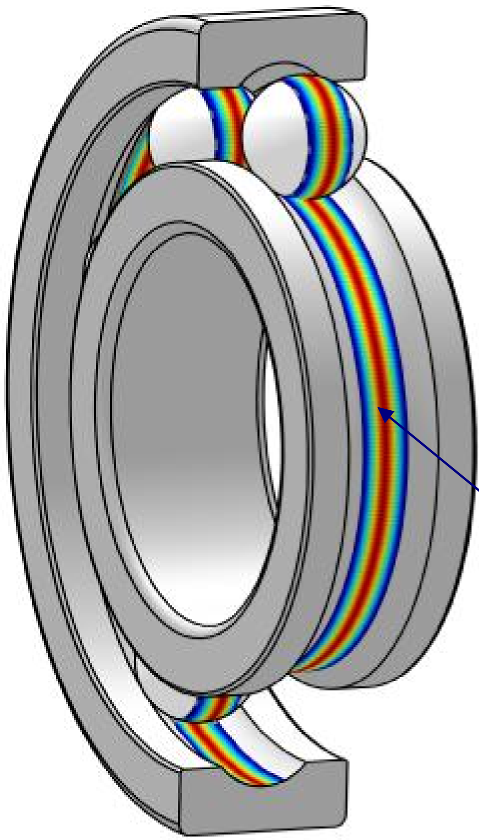


Aim of this research:

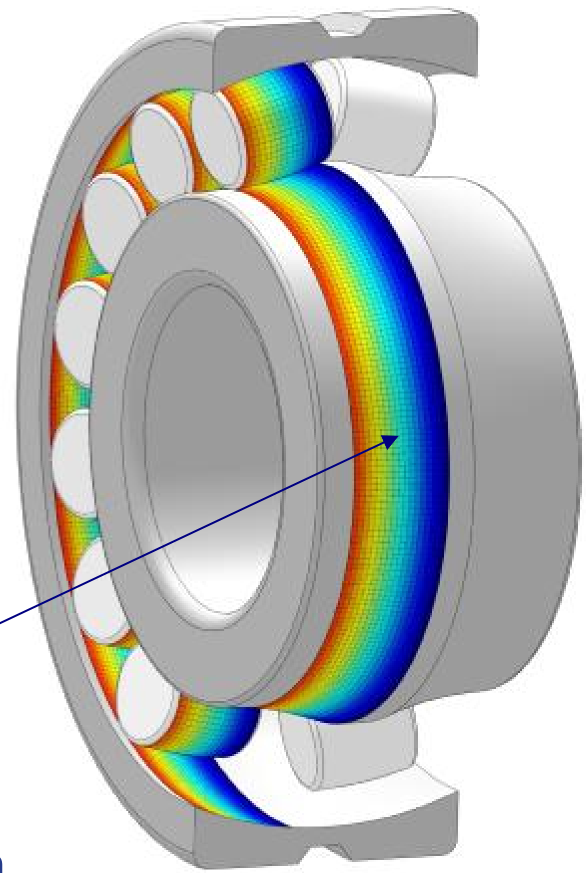
- Develop a model that predicts change supply layer thickness.
- Use this model to predict long term film thickness decay.

Introduction

Contact pressure effect



Centrifugal effect



Lubricant film
thickness distribution

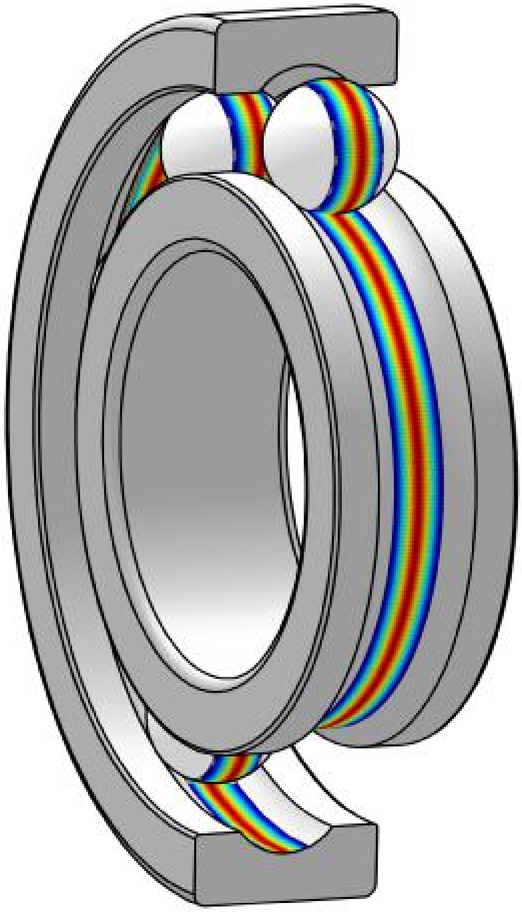
Theory

Model: contact pressure effect

- Rolling tracks are covered by a thin layer of lubricant.
- Lubricant is distributed evenly along the tracks.
- Considering flow due to “*high*” contact pressures:
  - Elastic deformation
  - Viscosity – Pressure dependence
  - Density – Pressure dependence
- For a symmetrical distribution:

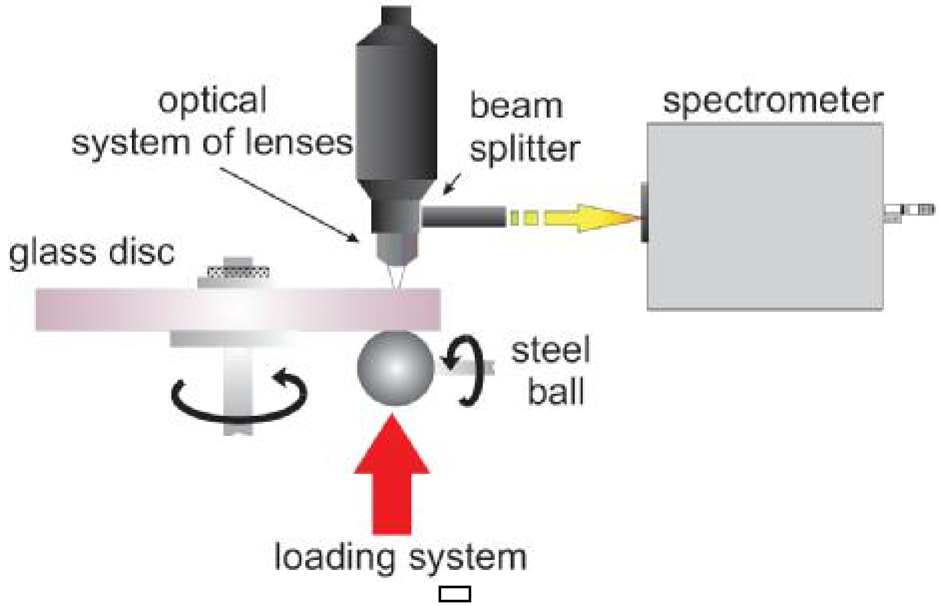
$$h(t) = \frac{1}{\sqrt{C\,t + h_0^{-2}}}$$

$$C = C\left(h_0, l_t, F, E', a\,, geometry\right)$$



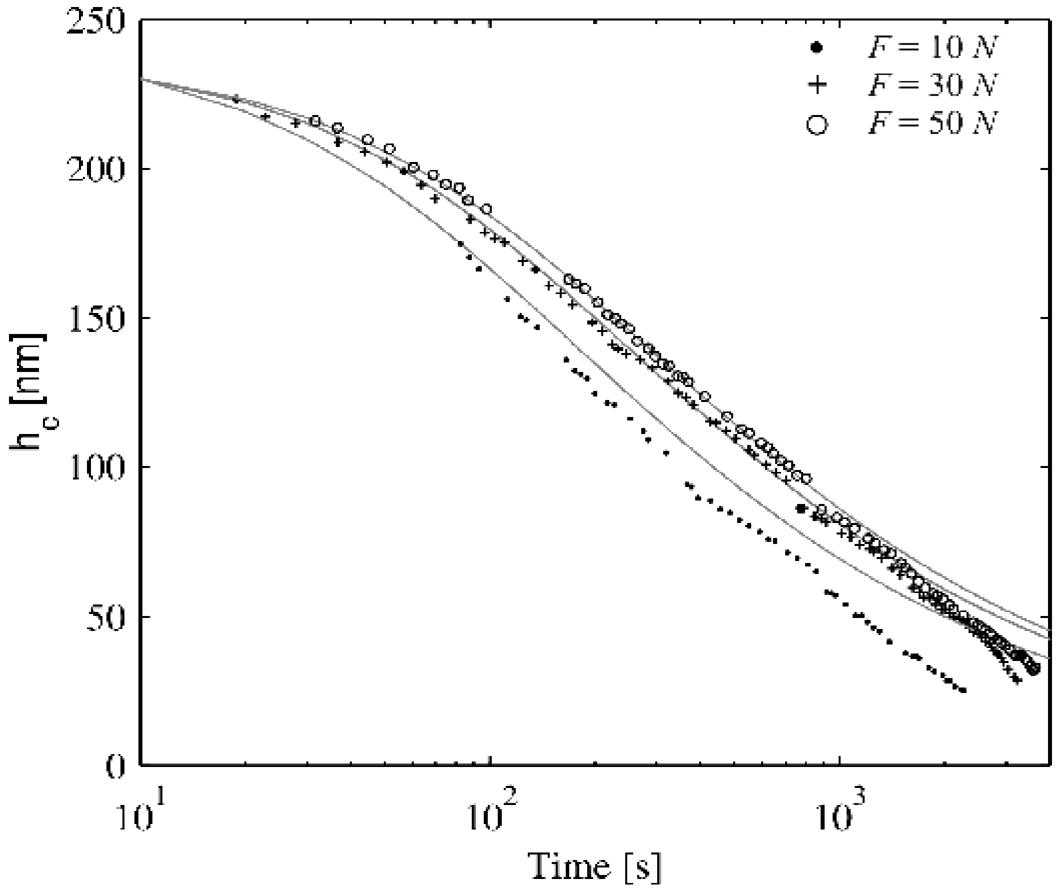
Experimental approach

- Roller loaded against rotating glass disk.
- Small droplet of oil.
- Film thickness is measured using optical interferometry.



Experimental results

Central film thickness - Different Loads



u_m = 186 mm/s, $\eta_0 \approx$ 0.8 Pa.s

Conclusion

- Grease life prediction: Film thickness is determined by supply layer.
- Model is developed to predict change of supply layer.
  - Centrifugal effects
  - Contact pressure effects
- Model is validated experimentally.