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Master Thesis: Abaqus Based Modelling of Roller Bearings

At the Transmission Simulation & System Design team, FE-analyses of housings and rotating parts of gearboxes and electrical drivelines for heavy trucks are a main staple. These components are usually connected with bearings that enable rotation. To achieve accurate force transfer and thus stress distribution close to a bearing seat it is necessary to have bearing models that are good enough. We have developed such models in Abaqus for over ten years. The current situation is that there are models of varying degree of maturity for ball, needle, and tapered and cylindrical roller bearings.

Such models must, depending on the requirements of the analyses attempted, be able to correctly describe either the average or local behavior of the bearings and thus provide FE-results of the desired detail level close to the bearings.

The objectives of the thesis work are:

- Cylindrical roller bearings and needle bearings are principally the same, needles are more slender than rollers, but initial findings indicate that their stiffness differ. This needs to be investigated and any threshold dimensions found.
- In order to model the detailed response of a specific point of a bearing seat when a roller rolls over the model has to be very detailed and allow the rings to deform for each individual roller. This has led to some very high aspect elements with associated numerical difficulties. Alternative solutions need to be investigated. To assess models in a good way it will be needed to analyze the distribution of the deformations, it consists of contributions from the rings, the rollers and the linear Hertz contact between them.
- In the current model the roller bearings are modelled with very non-linear springs. The compression of the roller body and the roller/raceway contact is moderately non-linear but the change from contact to play is severely non-linear. This means that the solution times may be unnecessarily long. Are there better ways to model this?
- (*Depends on software access*) Cylindrical roller bearings can react axial forces. Axial forces causes a tipping torque of the rollers, this is reacted by a redistribution of the contact forces between rollers and raceways. Thus, these two phenomena must be connected in the model. The current model has a token implementation of axial stiffness.
- (*If time allows*) There is a ball bearing model that has been developed for a specific ball bearing. It needs to be generalized to model different bearings correctly.

The current bearing models are created with a Matlab GUI. The work would include creating bearing models with the existing GUI as well as modifying the relevant parts of the code for the new implementations. The results of these models should be compared with results from dedicated commercial shaft and bearing analysis tool as well as some cases of detailed FEA with solid modelling of the rolling elements. Performing these detailed FEA:s is not part of the thesis work.

Qualifications & Key Attributes

- Master student in Engineering Physics, Mathematics or Applied Mechanics
- Positive attitude, willing to learn, disciplined, good communication skills, humble, result oriented
- Experiences in Abaqus and Matlab programming are a merit

Thesis Level: Master

Language: English

Starting date: 2021-01-18

Number of students: 1

Application
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Duration
The thesis project will start January 2021 and continue 20 weeks.
The diploma work gives 30 points.

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