LOSS OF LUBRICATION IN AN EHL CONTACT: A NUMERICAL APPROACH

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ABSTRACT
Inside mechanical systems, ball bearings or gears are either lubricated thanks to an external device or they have their own reservoir. The ball bearing is the perfect example. Some ball bearings possess seals and then are lubricated once during the assembling process. Other bearings without seals are lubricated thanks to splashing. In this case the mechanical component possesses a lubrication system which allows lubricant circulation. A common question for the sealed bearing is how can it work for hours only with a small amount of lubricant. Similarly, how long a bearing can work if the external device (e.g.: the oil pomp) has an issue and does not work.

Researchers investigated this phenomenon numerically as well as experimentally. Chevalier et al. [1] and van Zoelen [2] established analytical formulas to predict the film thickness decay of EHL contact under multiple overrolling validated with experimental work. Querlioz [3] investigated a Loss of Lubrication process on a MTM and obtained two different results. Depending on the operating conditions, the EHL contact reached a steady state or generated scuffing as shown schematically in Figure 1.

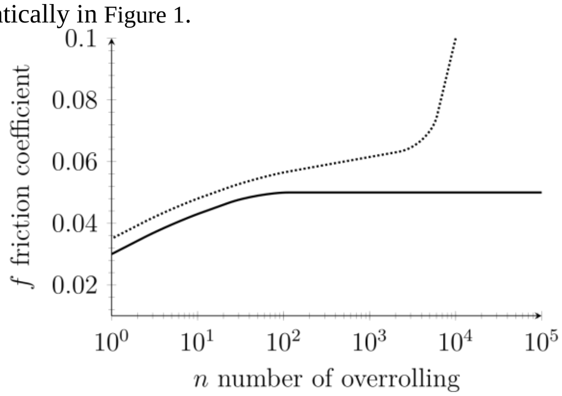

Figure 1: Consequence of a Loss of Lubrication process on friction

Figure 1 is a schematic reproduction of Querlioz [3] experimental results. The solid line represents the steady state behavior while the dotted one represents the experiment leading to scuffing (i.e.: sharp increasing of friction coefficient).

Using the numerical solver developed by Decote et al. [4], the experiments made by Querlioz have been reproduced numerically and compared to analytical formulas mentioned hereinbefore. Figure 2 shows the result obtained using Decote et al. solver.

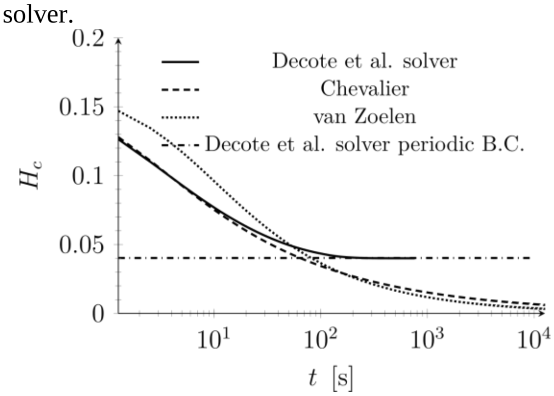

Figure 2: Numerical result for the film thickness decay

When thermal effects are negligible, the dimensionless central film thickness H_c reaches a steady state (without considering tack replenishment) which then implies a stabilized friction coefficient. Moreover, this result can be obtained doing only one computation thanks to periodic boundary condition. Analytical film thickness decay models do not predict this stabilization (H_c continues to decrease).

A thermal-EHL starved model is then developed to model scuffing cases.

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