A Review Report on PhD Dissertation entitled

Effects of Non-Newtonian Lubricants on Surface Roughness in Point Contacts

by Mrs. Ing. Ildiko Ficza

The purpose of this thesis is to develop a good EHL solver based on the multi-grid method, and to find the effect of non-Newtonian oil properties on the behavior of surface roughness under rolling-sliding EHL contacts. Such topics are surely update ones as described in the literature survey. That is, the understanding of the effect of surface roughness on tribo-characteristics of actual machine elements using the accurate numerical simulation technique is very important to improve the working performance, durability and reliability of numerous machine elements having a concentrated contact between non-conforming surfaces.

The author points out that higher order discretization is necessary to solve the Reynolds equation accurately and uses narrow upstream second order discretization in the numerical simulations. Furthermore, in order to have a fast and accurate solution under rolling-sliding conditions, the author compares the predefinition method of a number of iterations for each time step with the predefinition one of the order of residual tolerance at each time step, and adopts the former method. The author also tests many factors which influence the accuracy and calculating time, and adopts most appropriate ones to solve non-Newtonian steady and unsteady Reynolds equation. The author's work on this issue is great, because it is very difficult for a beginner to reach such a level, and the developed method will contribute very much to the numerical simulation in EHL regime.

The author applies the method to understand the behavior of surface roughness in rolling-sliding EHL contacts, and compares the results with experimental results carried out by the author and those obtained by other researchers. The discrepancies between them are discussed by comparing the effects of ridge shape, entrainment velocity, slide-roll ratio, pressure-viscosity coefficient, Eyring stress, ambient viscosity and compressibility. These results will give good qualitative information for the following beginners in the field of EHL. It is to be regretted that only the Eyring model is adopted in the simulations although several rheology models are discussed in the literature survey.

The aim of the author is however sufficiently established and the results of this thesis are important and valuable, and will contribute to the field of EHL. The construction of the thesis is good enough and the linguistic level is high.

In summary, Mrs. Ing. Ildiko Ficza should be awarded the PhD academic degree.

Questions:

1. As described by the author, there are numerous rheology models. Why did the author adopt the Eyring shear thinning model?

2. Fig. 6.16 shows the film profiles obtained in pure rolling. The film thickness is slightly larger for the Eyring model than for the Newtonian model. Could the author explain the reason?

On shortened version of PhD Thesis

1. The brief explanation of the newly developed numerical solver should be necessary.

2. The unit of abscissa in Figure 5.1 is mm/s.

3. Some data which are necessary to understand figures, such as mechanical and oil properties, should be added.

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