Homogenization of (elasto)hydrodynamic lubrication problems with rough surfaces

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The increasing presence of industrial devices, involving contacts lubricated by thin layers of fluid, motivates the interest to propose the more suitable mathematical models for the numerical simulation of such. In many practical situations the introduction of periodic roughness in the (deformable or not) surfaces is interesting during the manufacture. Within the framework of lubricated contacts between rough surfaces, the homogenization techniques allow to obtain suitable mathematical models for the efficient numerical simulation of the processes. The mathematical models are based on Reynolds type equations for the lubricant pressure and cavitation, nonlinear pressure-saturation laws and elastic models for pressure-deformation relation.

The present work treats on the homogenization of a problem of lubrication, by using double scale techniques. Mainly, an homogenized Reynolds-Hertz model is obtained, accounting the presence of effects due to rough surfaces with oscillations periodic and it incorporates associate elastic deformations to local contacts. The geometry of the rugosidad depends on associated to a small paremeter (the frequency). One of the main difficulties in homogenization is the nonlinear character of the model due to the free boundary associated to cavitation. Other difficulties arise from the nonlocal aspects of the Hertz model and the nonlinearity in the viscosity law.

Finally, numerical results for a real problem are presented to illustrate the theoretical convergences of the small parameter dependent model to the homogenized. For this purpose suitable numerical methods have been used.