ABSTRACT EXAMPLE: OPTIMIZATION OF MICRO-TEXTURED LUBRICATED DEVICES

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The need for ever-increasing performances in technology creates the need for incorporating optimal design tools into every piece of equipment. Concurrently, emerging fabrication procedures bring along the capability of tuning features, such as the microscopic texture of the surfaces, that were not accessible for detailed design a few years ago.

In this communication we report on some ongoing work concerning the analysis and design of lubricated mechanisms. In previous work we have considered the effect of roughness on rigid-disk magnetic-head sliders (see, e.g., Buscaglia and Jai, *Math. Problems in Engineering*, Vol. 7, 355–378 (2001)) and the optimal-load shape of compressible bearings (Jai, Buscaglia and Iordanoff, *ASME J. Tribology*, to appear). A few recent works have suggested the use of artificial surface textures for performance improvement of hydrodynamic bearings (Tagawa et al, *ASME J. Tribology*, Vol. 123, 151–158 (2001), Ronen et al, *Tribology Trans.*, Vol. 44, 359–366 (2001), Xu and Tsuchiyama, *Tribology International*, Vol. 36, 459–466 (2003)). It is known that the mathematically optimal bearings in terms of either load capacity or friction (Rohde, *ASME J. of Lubrication Technology*, April 1972, 188–192, July 1972, 275–279) do not have micro-scale features. It is however possible that some particular texture brings an overall improvement when load, friction, and other aspects such as dynamic stability are simultaneously considered.

As a first step, we consider a simple lubricated mechanism consisting of a slider flying over a smooth surface, assuming incompressibility of the bearing fluid. We study the effect of different textures, and look at the possibility of improving the slider's performance by using optimization tools applied to the transient Reynolds equation, with a penalization approach when cavitation effects are incorporated. The results show that friction-reducing textures indeed exist, and that their geometry strongly depends on the operating conditions of the slider. The design of *engineered micro-textures* should thus rely on computer-based optimization techniques as the ones outlined in this work.