EXPERIMENTAL AND SIMULATION ANALYSIS OF TEXTURED CONNECTING-ROD BIG-END BEARINGS FOR FRICTION REDUCTION

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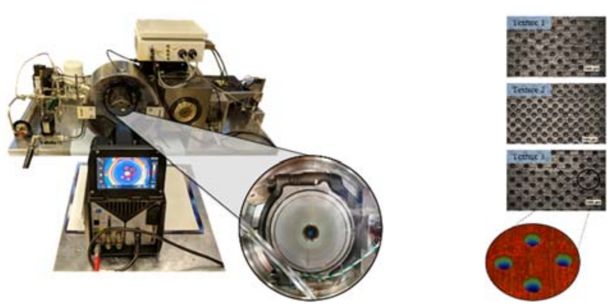
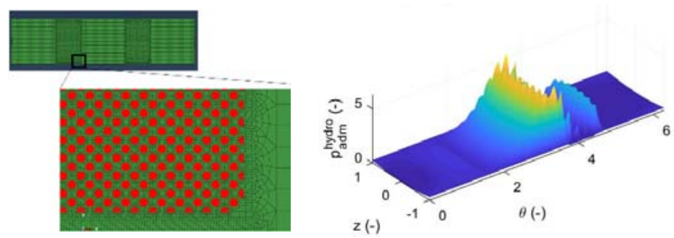
ABSTRACT
Journal bearings have wide applications in internal combustion engines (ICEs), including especially the main bearings responsible for supporting the crankshaft, as well as the big- and small-end bearings that link up the connecting-rod to the crankshaft and piston, respectively. On the account of the extensive applications of journal bearings in ICEs and its great impact on the engine mechanical efficiency [1], coupled with the challenges imposed by several technological trends aimed at improving the engine fuel economy, such as turbocharging and direct injection systems, the use of increasingly lower viscosity oils and the grows of start-stop systems, the development of novel tribological solutions for improving the bearings' performance and reliability is mandatory [2]. In this context, a potential alternative for optimising the performance of engine bearings is the application of surface texture [3]. Therefore, the present contribution is aimed at investigating, through experimental and numerical simulation analyses, the effect of different texture configurations on the friction behaviour of connecting-rod big-end bearings. The experimental part of the work was carried out using modified journal bearing rig designed to accommodate commercially ICE connecting-rod bearings [4] (Fig. 1), which also allows thermal monitoring base on a FLIP infrared camera and a series of thermocouples.



(a) (b)

Fig. 1 – (a) Experimental setup of the journal bearing rig. (b) Surface plots of the texture configurations as recorded by the optical profilometer.

The experimental data of three texture configurations were used to validate a numerical model based on the solution of Reynolds equation with a mass-conserving cavitation model, including global thermal effects [5] (Fig. 2). The plot of Fig. 3 shows a good agreement between simulation and experimental data when thermal correction was considered. Furthermore, the validated numerical model was used to investigate if dense surface texturing is equivalent to single pocket configurations for both friction reduction and side leakage.



(a) (b)

Fig. 2 – Representative examples of the simulation setup and results. (a) Local mesh refinement around the micro-textures. (b) Hydrodynamic pressure distribution for the textured bearing.

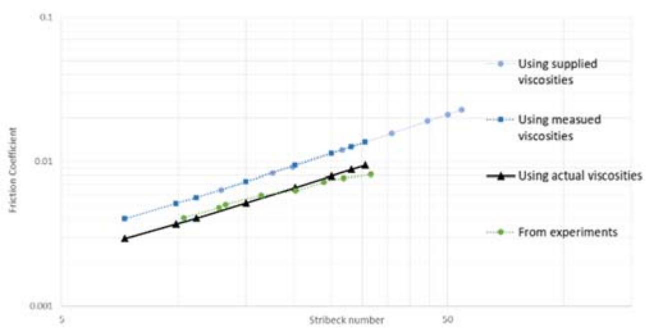


Fig. 3 – Stribeck curve for texture 3 under 1 kN. Notice the good agreement between experimental (green) and simulation (black) data.

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