

Parametric optimization of periodic textured surfaces for friction reduction in combustion engines

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Abstract

The aim of this paper is to analyze the tribological performance of different periodic textures of liner surfaces under hydrodynamic lubrication conditions, for an engine application. The impact of the different parameters of the periodic texture on its tribological performance is studied. First, a brief description of the numerical model is given. Then, the friction prediction tool is applied to the simulated periodic textures. Finally, optimal shapes and values of periodic textures are drawn out for the considered application.

Keywords: surface roughness, surface modification, laser texturing, hydrodynamic lubrication, friction, numerical tribometer, texture optimization.

Nomenclature

\mathcal{P}	The smooth plate simulating the piston ring
\mathcal{R}	The rough surface simulating the liner
Ω	The computation domain confined by \mathcal{P} and \mathcal{R}
l_1	Computation domain length on x_1 axis (m)
l_2	Computation domain length on x_2 axis (m)
l_3	Computation domain length on x_3 axis (m)
\vec{v}_p	Velocity of \mathcal{P} (m/s)
\vec{v}	Local fluid velocity (m/s)
p	Local fluid pressure (Pa)
p_1	Downstream pressure (Pa)
p_2	Upstream pressure (Pa)
ρ	Fluid density (kg/m^3)
η	Fluid viscosity ($Pa \cdot s$)