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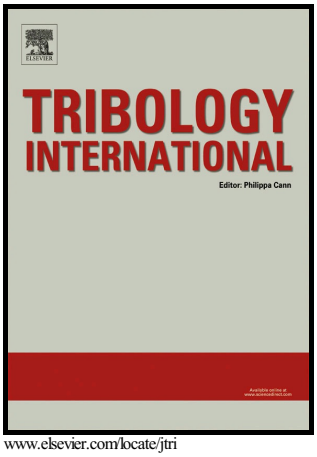

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A piston tribodynamic model with deterministic consideration of skirt surface grooves

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Abstract:

The machining micro-grooves on the piston skirt surface are very common in internal combustion engines. To accurately investigate the influence of the grooves on piston tribodynamic performance, a coupling model of piston skirt-liner lubrication and crank-rod-piston multibody dynamics is built in this study. The lubrication model is solved by the Finite Element Method with deterministic treatment of the grooves. The multibody dynamics equations are formulated with Lagrange multipliers and constraint Jacobian matrix in the form of Differential Algebraic Equations (DAEs). The MEBDF approach is applied to a high efficient time integration of the DAEs. Based on the above model, the influences of grooves and some groove parameters on piston skirt-liner lubrication as well as piston slap are studied and revealed.

Keywords: Piston skirt, Surface grooves, Multibody dynamics, MEBDF

Nomenclature

a	vertical distance between the piston pin and the top of the skirt
b	vertical distance between the center of mass (COM) and the top of the skirt
C_g	horizontal distance between piston COM and piston pin
C_p	piston pin offset
C	nominal diametric clearance between piston skirt and liner
c	nominal radial clearance between piston skirt and liner
e_0	the lateral displacement of piston
F_n	total normal force acting on piston
F_f	total friction force acting on piston
F_c	total centrifugal force acting on piston
F_g	combustion gas force acting
h	oil film thickness