

MECHANICAL ENGINEERING STUDENT SEMINAR

Thursday, July 13 2023 at 13:00, D. Dan and Betty Kahn Building, Auditorium 1.

Online: <https://technion.zoom.us/j/92686226001>

Dynamic analysis for optimizing tribological performance of ringless piston-cylinder systems

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The Piston-Cylinder pair is very common in industrial mechanisms, and while the piston is primarily designed for axial reciprocating motion, the occurrence of secondary motion—lateral and rotational—due to the small clearance between the piston and the cylinder may lead to frictional contact and increase of the unwanted leakage that leads to energy loss and wear. Extensive studies have been conducted to reduce the energy loss and wear and various solutions have been proposed. One promising solution is the implementation of surface texturing, which can generate, if properly designed, separating hydrodynamic forces to stabilize the secondary motion.

This study focuses on a ringless piston in a piston-cylinder system. The effect of the Rayleigh step bearing and the partial surface texturing on the dynamic stability of the secondary motion of the piston is studied. A numerical model for simultaneous solution of the lubrication and the dynamic equations was developed. The lubrication equations were modeled by both Reynolds equations and the more general Navier-Stokes equations. The computational fluid dynamics (CFD) was used to discuss the validity of Reynolds equation in the presence of the secondary motion and for investigating the impact of partial surface texturing on various lubrication applications. A linear model for the secondary motion was developed and validated, based on CFD simulations. Floquet theory was used for the stability analysis and stability maps were drawn for various texturing parameters and operating conditions.

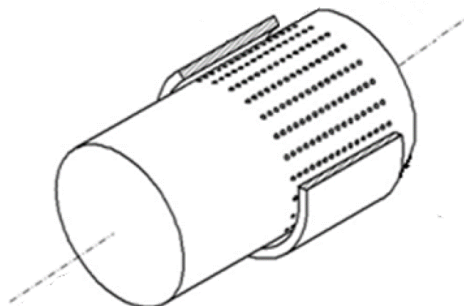


Illustration of partially textured ringless piston

Note: the seminar will be given in Hebrew