Controllable Elastohydrodynamics With Examples

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Due to the development of high performance rotating machinery, growing attention has been paid to the design of new active (mechatronic) devices able to actively control vibrations and improve its dynamic behavior, i.e. magnetic bearings piezoelectric bearing pushers, hydraulic actuator journal bearings, variable impedance bearings, actively controlled bearing surface profiles or simply deformable bushes, active journal bearings with flexible sleeves, active lubricated bearings or pressurized bearings among others.

The active systems composed of deformable bushes, journal bearings with flexible sleeves and active lubricated bearings belongs to a special category of tribological devices where “controllable” elastohydrodynamics plays an crucial role. In such devices the bearing surface profile is intentionally modified and/or adjusted in order to control rotor vibrations and improve bearing dynamic properties. The actively controlled bearing surface profiles can be generated by attaching any kind of actuator (hydraulic, electromagnetic or piezoelectric) to deformable bushes.

In this paper the elastohydrodynamic model is used to investigate static and dynamic properties of a tilting-pad journal bearing under hybrid elastohydrodynamics (open loop control) as well as controllable radial oil injection (closed loop control).

The bearing dynamic coefficients are heavily influenced by the control parameters and pad compliance. Strong synergy between elastohydrodynamics and active control is observed, in particular for bearings with injection orifices far from the pivot line.