VIRTUAL TEXTURED HYBRID BEARINGS

Stefan G.E. Lampaert [a*], Ron A.J. van Ostayen [a]
*S.G.E.Lampaert@tudelft.nl
[a] Delft University of Technology,
Mekelweg 2, 2628 CD Delft, The Netherlands

Magnetorheology; Electrorheology; Hydrostatic bearing; Virtual texturing; Tribotronics

INTRODUCTION

In order to achieve low wear and friction, full film lubrication is desirable since this guarantees no contact between the bearing surfaces and so no wear. Full film lubricated bearings can be divided into hydrodynamic (HD) bearings and hydrostatic (HS) bearings. HD bearings are a low cost and low friction solution, however they require a sufficiently high speed to ensure zero mechanical contact between the moving surfaces. HS bearings exhibit zero contact at all operating speeds but have the drawback that they rely on a failure sensitive supply pump (Fig.1). Hybrid bearings combine the advantages of both bearing types, but their design is regularly a trade-off between both operating regimes [1], as the surface texturing needed for an optimal HS working regime decreases the efficiency of the HD working regime and vice versa.

VIRTUAL TEXTURED JOURNAL BEARING

This work presents a new type of hybrid bearing that does not compromise between the HD and HS working regimes. This so called "Virtual Textured Bearing" uses a local variation of the viscosity of the lubricant to modify the local resistance (Fig 2.). This can be realized with for example a magnetorheological fluid (MRF) or an electrorheological fluid (ERF). This furthermore facilitates active control of the bearing as is done in [2].

The absence of physical texturing results in a conventional converging wedge that better facilitates HD lubrication (Fig. 3). Supply inlets in the journal together with virtual texturing adds HS lubrication to the bearing operation. This yields a bearing system that predominantly uses HS lubrication at low speeds and naturally switches to efficient HD lubrication at high speeds.

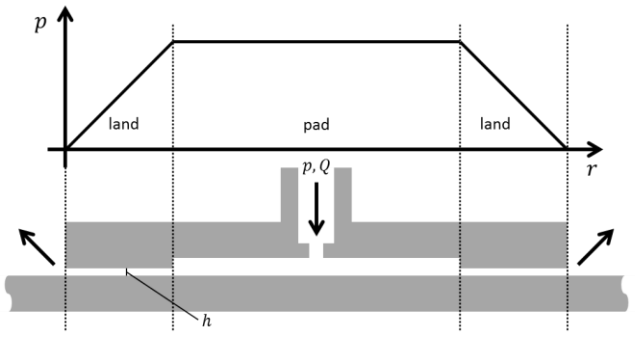

Fig. 1. Conventional HS bearing: resistance is increased locally by decreasing the bearing gap h.

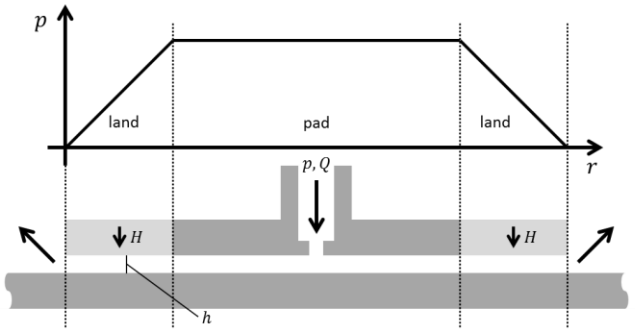

Fig. 2. Virtual textured HS bearing: resistance is increased locally by using an MRF and a local magnetic field.

Fig. 3. Virtual textured journal bearing: A smooth bore journal bearing is supplied through the holes with a MR-lubricant. Virtual recesses are created by the magnetic field created in the dark zones. In operation both hydrostatic and hydrodynamic load carrying capacity is generated.

REFERENCES

[1] K. L. Wasson and A. H. Slocum, "Integrated Shaft Selfcompensating Hydrostatic Bearing," 1997.
[2] J. Hesselbach and C. Abel-Keilhack, "Active hydrostatic bearing with magnetorheological fluid," *J. Appl. Phys.*, vol. 93, no. 10, pp. 8441–8443, 2003.