Performance of Thrust Bearings Lubricated with Multiphase Flow

NEW PROPOSAL

Dr. Adolfo Delgado, Associate Professor
Travis Greenstreet, Research Assistant

Jun 2021

Introduction

Electrical submersible pumps (ESPs) are artificial lift devices widely used in the oil and gas industry to increase production. For unconventional wells, which includes subsea applications, installation cost is an order of magnitude higher than the cost of the typical ESP, thus pump reliability is paramount. Contamination of the thrust bearing lubricant oil by process fluid due to seal failures is one of the leading causes of thrust bearing failure. While improving seal reliability can prevent thrust bearing failures, an alternative approach is to develop process-fluid lubricated thrust bearings. This research aims to characterize and study the performance of thrust bearings operating with process fluid lubrication, including multiphase flow (water and air).

Fig.1 Tilting pad bearing used in submersible pumps

A component level-level test rig and tilting pad bearings are available for testing. The test rig, shown in Figure 2, features a vertically mounted configuration and a flooded test bearing chamber. Its three major subassemblies are the load driving assembly, slave bearing spindle assembly, and support structure assembly. The load driving assembly is completely removable to allow for quick test bearing access, and the test chamber is sealed to isolate the slave bearings from the process lubrication present in the test bearing area. Three hydraulic cylinders apply a maximum axial force of 30,000 lbf (133.4 kN) onto the test bearing. A torque-limiting coupling protects the motor from overload in case of test bearing seizure. The test chamber features three load cells, one for each hydraulic piston, three water submersible proximity probes to measure bearing deflection and hydrodynamic film thickness, and ten temperature sensors, thermocouples or RTDs depending on the application, to monitor bearing temperature. A tandem torque meter/tachometer installed between the coupling and the motor provides the system torque and shaft speed.

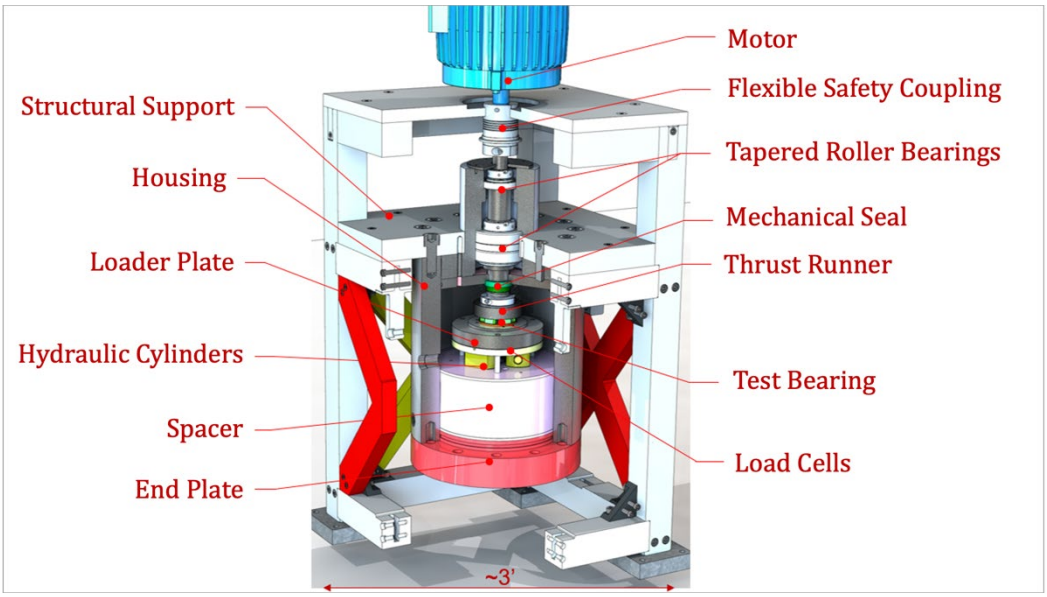

Fig. 2. Section cut view of test rig with components labeled.

Proposed work

Conduct load capacity test on 3 thrust bearings (Tungsten carbide, silicon carbide and peek) while increasing GVF until failure. The bearings will be inspected after each GVF condition to evaluate surface degradation. The measurements will include pad temperature, torque and axial motion (indirect film thickness measurements).

Budget

Graduate Student Payroll, 12 months @ $2200/month	$ 26,400
Fringe Benefits	$ 5,755
Tuition and fees	$ 13,275
Hardware	$ 4,570
Total	$ 50,000