



Continuation Project
Linear-Nonlinear Force Coefficients for Squeeze Film Dampers

Experimental Response of a Sealed Ends Squeeze Film Damper to Intermittent Impact Loads

High performance turbomachinery demands high shaft speeds, increased rotor flexibility, tighter clearances in the flow passages, advanced materials, and increased tolerance to imbalance. Operation at high speeds induces severe dynamic loading with large amplitude journal motions at the bearing supports. Squeeze Film Dampers (SFDs) are effective means to ameliorate rotor vibration amplitudes and to suppress instability in rotor-bearing systems. A SFD is not an off-the-self mechanical element but tailored to a particular rotor-bearing system as its design must satisfy a desired damping ratio; if too low, the damper is ineffective, whereas if damping is too large, it locks the system aggravating the system response. At times, SFDs are also employed to control the placement of (rigid body) critical speeds displacing the machine operation into a shaft speed range with effective structural isolation.

Industry demands well-engineered SFDs with a low footprint to reduce cost, maintenance, weight, and space while pushing for higher operating shaft speeds to increase power output. Piston ring seals are common in aircraft SFD applications and will be used in the next phase of the project. Hence, during year V, the proposed work includes:

- (a) Revamping test rig: Assembly and alignment of journal to bearing cartridge; film clearance $c=0.254$ mm.
- (b) Re-design DAQ system: Improve measurement capability during fast transient responses.
- (c) Characterize flow conductance of piston rings for a range of supply pressure and flow rate.
- (d) Apply intermittent impact loads (of increasing magnitude) on the open ends SFD and the sealed ends SFD to inducing transient motions departing from centered and off-centered conditions.
- (e) Extend the frequency domain method for parameter identification to consider time spans with multiple impact-loads.
- (f) Compare test results for both the sealed ends SFD and the open ends SFD and demonstrate the effectiveness of the end seals for increasing damping capability.