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Experimental Investigation of the Morton Effect

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The Morton effect (ME) is a thermally induced instability problem that most commonly appears in rotating shafts with large overhung masses and supported by fluid film bearings. The time-varying thermal bow due to the asymmetric journal temperature distribution may cause intolerable synchronous vibrations that exhibit a hysteresis behavior with respect to rotor speed. First discovered by Morton in the 1970s and theoretically analyzed by Keogh and Morton in the 1990s, the ME is still not fully understood by industry and academia experts.

The journal inside the fluid film bearing has long been assumed to be isothermal until recently, and engineers realize that under certain conditions high temperature difference (ΔT) can develop across the journal circumference, bending the shaft and possibly causing instability problem in rotordynamics, termed “Morton effect” (ME). The initial version of the ME test rig developed by this lab featured a tilt pad bearing between ball bearings with an eccentric rotor. This rotor had RTDs embedded around the circumference and the data from these sensors verified the predictions from the ME prediction software. Version 2.0 of the ME test rig will feature a much larger shaft and axially spaced RTDs in addition to the circumferential spacing. The rig is expected to produce ME between 5100-5500 rpm. Once the rig is constructed and consistently exhibits ME, parameters can be varied to study their effects on the system in a controlled manner. This will provide much needed additional data in the study of ME and provide a rig on which ME countermeasures can be tested in the future.