Stability Performance Comparison of Rotor-Bearing Systems Supported on Conventional and Hybrid Journal Bearings

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ABSTRACT

New closed form expressions for calculating the linear stability thresholds for rigid and flexible Jeffcott systems as well as the imbalance response for a rotor supported on a hybrid bearing are presented. Comparing stability values using the expression here developed to that obtained by Lund the thresholds are practically the same. By *hybrid* we mean a circular journal bearing that works with both, a hydrodynamic wedge plus lubricant injection at substantial pressure.

The hybrid bearing has a design configuration with a single injection port. Location of such injection is so chosen that it helps stabilizing the bearing performance, likewise the resultant equilibrium attitude angle is reduced. Rotordynamic coefficients graphs for conventional and the pressurized bearing as functions of bearing equilibrium eccentricity and/or Sommerfeld number are presented. Feeding such rotordynamic coefficients into the expressions for both, the corresponding velocity thresholds and the imbalance response, the system stability and vibration performances are estimated.
Important to mention that when comparing the Jeffcott flexible shaft supported on two journal bearings of the conventional type to that of this hybrid type, results show a clear superiority of the injected design as far as stability behavior is concerned. Specifically, for cases of flexible shafts with characteristics similar to the ones used in industry, this simplified analysis shows that usage of this hybrid bearing design yields a velocity threshold between 25% to 40% higher than the conventional circular ones. Moreover, this hybrid design is capable of reducing the synchronous vibration amplitude in most speed ranges, except around the critical speed; for certain Jeffcott configurations the amplitude reduction can be substantial.