Start-up Dynamic Analysis of a Rotor Supported by Fluid Film Bearings

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Abstract: Start-up and steady-state dynamics of a rotor supported by fluid film bearings is studied. A rotor is assumed as a thin disk located on the middle of an elastic shaft, which is supported by fluid film bearings. The journal bearing is selected as a short-plain type and it is represented by direct and cross-coupling stiffness and damping coefficients, which are angular speed dependent. An electric motor accelerates the rotor and its speed is controlled by a second order transfer function. Simulation results show that for a certain angular speed range the system becomes unstable. The instability region has lower and upper limits. The journal bearings affect the rotor, the equivalent damping ratios and the natural frequencies in x and y directions differ and cause 2x-critical speed super-harmonic oscillations. Before the lower limit of the unstable region, the journal whirl speed is equal to one-half of the rotor angular speed and the equivalent natural frequencies of the rotor in x and y directions are equal to the critical speed. After the upper limit of the unstable region, the journal whirl speed is always equal to the critical speed and one of the equivalent natural frequencies of the rotor becomes one-half of the rotor angular speed. In this region high amplitude 2x-critical speed super-harmonic oscillations appear.

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