Shaft mass effect on the dynamic behaviour of a rotor supported by fluid film bearings

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Abstract: Shaft mass effect on the dynamic behaviour of a rotor supported by fluid film bearings is studied. The rotor is assumed as a thin disc located on the middle of an elastic shaft, which is supported by fluid film bearings. Non-zero elastic shaft mass is considered. The journal bearing is assumed as a short-plain type and it is represented by direct and cross-coupling stiffness and damping coefficients. These coefficients depend on the angular speed of the system. It is assumed that an electric motor accelerates the rotor. The electric motor speed is assumed to be controlled by a second-order transfer function. Simulation results show that for small values of mass ratio, which is defined as the ratio of the shaft mass to the disc mass, one pair of complex roots assumes positive real part for a range of rotor speeds and makes the system unstable. As the mass ratio increases, this pair of root becomes stable, but the other pair of complex roots assumes positive real parts and the system becomes unstable again. The system is always stable for subcritical run but unstable for some speed range for the supercritical run.

Keywords: Jeffcott rotor, shaft mass, fluid film bearings, subcritical run, supercritical run