the range for Moody's friction factor model to be valid. Could the authors explain this issue? I would like to add that for the example presented, surface roughness values on the order of 2 percent of seal clearance give similar results as those presented by the authors using the computer program of San Andres (1991). The inlet swirl is taken as 60 percent of the rotor surface speed and the numerical predictions show large values of the cross-coupled stiffness which bring the whirl frequency ratio to values close to 0.60. In this respect, I consider the results rather unusual since the use of a roughened stator surface is precisely desired to reduce leakage and improve the seal dynamic stability characteristics (i.e., reduce WFR). Then, in this application a roughened seal surface is clearly not beneficial which seems rather relevant (if correct). Could the authors explain more in detail this issue?

The whirl frequency ratio formula presented is due to Lund (1965). San Andres (1990) extended the original analysis to include inertia force coefficients. In regard to the WFR it was found that the cross-coupled inertia coefficient, $M_{XY} > 0$, has a detrimental effect on the stability ratio.

The investigation has shown that rotor-tilt relative to the seal inlet plane produces a significant increase in direct stiffnesses. This effect could be completely reversed if the tilt is relative to the seal exit plane as some of my recent calculations show. Have the authors also found the same behavior in their studies?

Additional References


D. Elrod

Nelson and Nguyen (1987) showed that the choice of a friction factor equation affects seal rotordynamic coefficient predictions for nominally centered seals. Would the authors comment on the probability that the predicted dependence of rotordynamic coefficients on tilt is affected significantly by the choice of a friction factor equation?

A better understanding of and appreciation for this work would be gained from plots of the nominal "zeroth-order") pressure profiles around the circumference of the seal. For example, one presumes that the pressure profile at $\theta = \pi$ differs from that at $\theta = 0$. This would lead to a prediction that the stiffness in the tilt direction depends on the direction of perturbation along the axis.

Finally, would the authors clarify the clearance function in Eq. (5)? For the eccentric journal in Fig. 13, the clearances $BD$ and $BF$ are

$$BD = R + C_0 - (R^2 - e^2\sin^2\phi)^{1/2} - e\cos\phi$$

and

$$BF = \sqrt{(R + C_0 - e\cos\theta)^2 + e^2\sin^2\theta}^{1/2} - R$$

in which $R$ is the rotor radius, $C_0$ is the difference between the stator and rotor radii, and $e$ is the distance from the stator center to the rotor center. What clearance does Eq. (5) represent?