DISCUSSION

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The author continued to refine the model for calculating dynamic seal coefficients by considering the seal of finite length instead of the short seal assumption. The results showed that finite seal solution predicted lower stiffness and damping coefficients than short seal solution did, but gradually converged to it as L/D is decreased for zero inlet swirl. It is noted that direct stiffness coefficient increased as L/D increased from 0.2 to 0.5 and decreased as L/D increased from 0.5 to 1.0. What would be the explanation for this variation?

The results also showed the reduction of cross coupled stiffness and damping coefficients due to inlet swirl. However, since finite seal solution yielded negative cross coupled stiffness which is physically impossible, the model needs to be reviewed.

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Author's Closure

Concerning the discusser's first question, the direct stiffness K is hydrostatic in nature, arising due to the balance of ΔP absorbed between the entrance loss $(1+\xi)\,\rho V^2/2$ and wall friction $\sigma\rho V^2$. If, as in the present example, all other conditions are maintained constant and only the length varied, an optimum length can be found which maximizes stiffness. In fact, if the length is increased sufficiently, a negative value for K results. Note, however, that the remaining rotordynamic coefficients continue to increase with increasing L.

The second question by the discusser concerns the turbulent model predictions for $v_0=-0.5$, i.e., flow entering the seal with zero tangential velocity. As stated in the paper, the author feels that Hirs' model has simply been pushed too far in the present application; specifically short seals with $v_0=-0.5$. Hirs and other conventionally-employed turbulent lubrication models work adequately in explaining small deviations from steady-state flow conditions, while the present application involves an order-of-magnitude deviation from the asymptotic circumferential flow condition $U_{\theta 0}=R\omega/2$. The applicability of other conventional turbulent lubrication models [9], [10] for these flow conditions also remains to be demonstrated.