with a pressure equation (26) that is similar to the classical Reynolds equation of lubrication. There are no rotations involved in the present application, thus the right hand side of the equation does not contain a corresponding viscous term.

Calculations, some of which are displayed in this paper, show the present theory to be accurate for aspect ratios up to $L/D = 2$.

Inertia effects are important at small values of the eccentricity ratio and large values of the gap Reynolds number. When its right hand side is supplemented with the viscous rotational term, equation (26) yields journal bearing attitude angles which are in excess of 90 deg in the above defined region (small ϵ, large Re) of parameter space.

As ϵ increases above 0.5 inertia loses its signficance, when compared to damping or, in the case of a journal bearing, stiffness effects.

Inertia effects are shown to be important for dampers with large clearance (C), high orbital frequency (ω) and small lubricant viscosity (ν).

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DISCUSSION

D. Hibner

Congratulations are extended to the authors for producing a concise formulation for fluid inertia effects for Poiseuille dominated flow. It is certainly a valuable contribution to the literature. The significance of fluid inertia has been ignored because JB theory was directly applied to SFD; your results may alter this neglect. However, I have three concerns:

1) You appear to have neglected the viscous shear positive stiffness force, as defined in reference [5], which exists for nonzero eccentricity ratio and cavitated film. This force will be directly opposite the negative inertia stiffness force and must be considered to determine if fluid inertia effects are important. In a dynamic systems analysis, not only the magnitude of stiffness but its sign must be recognized, and for a reasonable range of Reynolds numbers (1-20) and eccentricity ratio (.1-.9), the viscous shear stiffness force can be shown to range from 1 to 15 times the inertia stiffness force. Shouldn't you calculate and define the stiffness and rewrite equation (31) to include $K\zeta$ terms as in reference [5]?

2) Since most squeeze film dampers are sealed at both ends, I believe an $L/D=\infty$ line on your Figs. 4-7 would be most helpful. However, using $L/D=2$, comparing this to $L/D=.1$ and seeing negligible difference, I feel justified in comparing your inertia to damping force ratio (Table 1) to a simple formula presented by Tichy [1]. His formula is "exact" for small eccentricity ratio and Reynolds number, but large L/D ratio,

$$\frac{\text{Inertia Force}}{\text{Damper Force}} = \frac{1}{10}\text{Re}$$

Can you comment on the 36 percent difference which arises? Is it due to your averaging technique?

3) Reflecting on the significance of L/D ratio noted in Comment 2, suggests that both $L=\infty$ and $L=0$ dampers have similar inertia to damping force ratios. Considering the large differences in the velocity and acceleration fields between these two extremes, does it not seem strange that viscous and inertia pressures decrease proportionally with decreasing L/D ratio?

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Authors' Closure

The authors are grateful to Dr. Hibner for his kind words and his interest in their paper.

The analysis is performed in this paper is for small L/D although it is found to perform considerably better at intermediate values of L/D than a direct "short bearing" analysis would (Fig. 8). Had we had large L/D in mind, we would have employed a "long bearing" approximation in place of (24). As to another point raised by the discusser, we find in equation (25) that the viscous effect is of order (δ/R); viscous stiffness was neglected on this basis. There is no difficulty, however, in retaining the viscous term in equation (26). By setting $\delta=R$, equation (25) is approximately applicable to journal bearings. In this latter form, equation (25) has been used sucessfully to investigate inertial effects in journal bearings. [11].

The authors were unable to locate Tichy's "simple formula." It does not seem to be in reference [1], nor in any other of the references quoted. They thus decline to make further comments.