Conclusions

A novel analysis for the dynamic force response of squeeze film dampers with a central groove is introduced. The analysis considers with some detail the dynamic flow interaction between the squeeze film lands and the feeding groove. For small amplitude centered motions and based on the short bearing assumption, the model determines corrected values for the damping and inertia force coefficients which reflect the importance of the groove volume—fluid compressibility effect on the dynamic force response of SFDs.

Correlations with experimental measurements available in the literature show the accuracy of the present analysis. The comparisons presented show that the grooved-damper behaves at low frequencies as a single land damper of effective length equal to the sum of the land lengths and groove width. The novel analytical formulation resolves theoretically the long suspected effect of a central groove in a SFD and, it also brings to attention that current considerations used in actual damper design and operation may be incorrect.

Dynamic force coefficients are shown to be frequency dependent. Predictions show that the combined action of fluid inertia and groove volume—liquid compressibility affects the force coefficients for dynamic excitation at large frequencies.

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DISCUSSION

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The author provides an interesting well-written paper with an explanation for the differences between the large experimentally observed values of damping and inertia and those predicted by conventional short-bearing squeeze-film theory. A formulation allowing for fluid compressibility in the central groove is derived and apparently gives good results.

There may be a typographical error in Eq. (19) as the discussers were unable to reproduce the calculated value for M_{rr} in Table 1. An indirect approach was used since the oscillation frequency ω and compressibility β were not stated. It was also found that with Π values close to unity, M_{rr} becomes negative. The author's comments on this would be of interest.

In comparing the results with Ramli et al. (1987) it is not clear how the experimental values in Table 1 were obtained and for what frequency. It is also noted that Ramli et al. (1987) report a groove depth Hg = 0.5 mm rather than 5 mm. This may make a difference to the inertia coefficient from Eq. (19).

Author's Closure

The author thanks the reviewers for their kind compliments on the present analysis. In reference to the reviewer's comments I note that:

- The typographical error in Eq. (19) has been corrected on the final revised form of the paper.
- The experimental results of Ramli et al. (1987) refer to a damper with a groove depth equal to 0.5 mm. This typographical error is also corrected on the final version of the paper.
- In the experimental results of Ramli et al. (1987), the groove depth is so small ($Hg/c = 2.0$) that the damper acts effectively as a single land damper with equivalent length equal to the sum of land lengths and groove axial length. For the calculations, a light oil with a bulk modulus equal to 1.72 GPa (250 Kpsi) was used. The force coefficients were evaluated at fre-

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quencies ranging from 50 to 128 Hz. The experimental results do not show great evidency of frequency dependency since the test frequencies were relatively low even for a practical application.

I do apologize for the involuntary omissions and typos. Recent experimental work on grooved dampers at Texas A&M shows that the groove volume-circumferential flow effect in a damper of short axial length is of importance. These results have motivated a review of the present theory in order to better predict the measured results. The outcome of this analysis and corresponding experimental results will be reported on in the near future.