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DISCUSSION

G. Bayada[1]

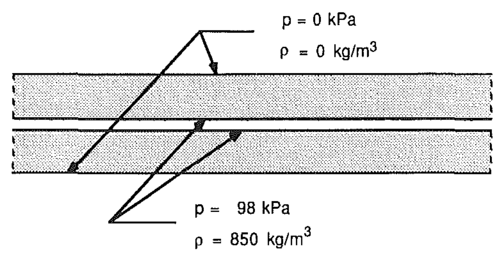
The authors have performed an interesting comparison of two simulation results (and some experimental results), the first one with a conventional "quasi-static" cavitation algorithm, the second one with a new algorithm taking mass flow conservation through the whole surface of the bearing into account. The underlying question being: In what cases is it interesting to use the new more costly (I suppose) algorithm?

And the answer could be: In the two cases, solutions obtained with the new algorithm are closer to experimental measures. For the steadily rotating Lundholm journal bearing only the flow differs between the two models while for the pure transient Phelan bearing both load and flows differ.

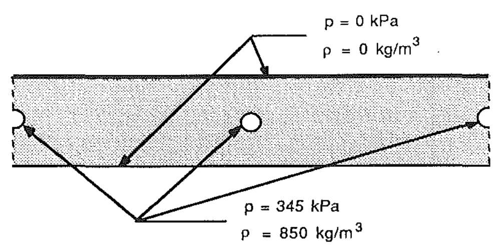
Such results are not surprising as the "new" algorithm is concerned with the Jakobson-Floberg-Elrod model of cavitation for the resolution of which other algorithms already exist (Bayada et al., 1990; Brewe, 1986; Elrod, 1981) and these authors, following the same methodology, compared their results with those obtained using nonconservative Gumbel solution. Insensitivity of the load has been pointed out and discussed (see also Lebeck comments in the discussion of Brewe's paper). Have the authors any views of predicting for what kind of devices the new JFO model must be used?

The discusser is skeptical about the necessity of assuming boundary conditions on both pressure and vapor density at the bearing ends for the Lundholm bearing; mathematically, only the first one must be a data. How is this supplementary value chosen?

Finally, can the authors give a comparison of the time consumption between the two algorithms?



***(a)* Lundholm bearing (Case I)**



***(b)* Phelan bearing (Case I)**

Fig. C1 Boundary conditions (overspecified)

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Authors' Closure

As evidenced by his comments and first Additional Reference, Professor Bayada is an extremely knowledgeable discusser on this topic, and his questions become successively more difficult:

His first question regarding the putative value of our algorithm seems rhetorical, and the answers he suggests are satisfactory as they stand.

Regarding the issue of potential applications, we quote from our text, "Though mass conservation may not always be a particularly important determinant of journal motion, the attribute becomes critical when external load must be carried by film portions which may instantaneously be incompletely filled with liquid." We can only speculate that such is probably *always* the case in wristpin bearings and *often* so for other engine bearings as well. It may also happen in squeeze-film dampers, but that is much less clear.

Initial and boundary conditions proposed in the Problem Formulation (and amplified in footnotes 4 and 5) of our *previous* paper (describing the algorithm) continue to vex both readers and authors. We believe that there can be boundary

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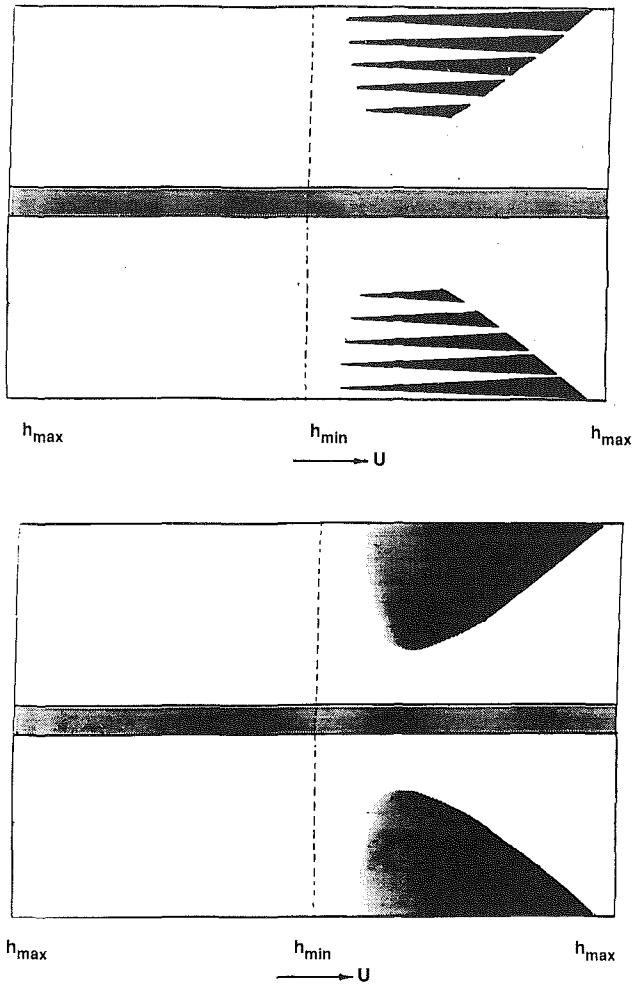

Fig. C2 Lundholm bearing: spatial averaging

segments where consistent values of *both* pressure *and* density must be specified. It appears that density must be specified only on boundary segments where mass flux is inward (even though such boundary segments may be impossible to identify *a priori*). In our numerical algorithm, however, we simply specify density on the entire boundary and rely on the "upwinding" scheme to select out the necessary information. Figure C1 shows the (overspecified) boundary conditions appropriate to both the Lundholm and Phelan bearings.

It is difficult to make simple computation time comparisons between the conservative (dynamic) and nonconservative (quasistatic) algorithms. If the same (small) time step is used for both, the conservative algorithm is actually a bit faster (apparently because it requires less iteration). However, the nonconservative algorithm is capable of running with much larger time steps, and thus is generally much faster.

Less knowledgeable readers than Professor Bayada may find Fig. C2 helpful in visualizing the spatial averaging of fluid density inherent in the JFO model(s) on which the present work is based. Fig. C2 suggests the conceptual equivalence of discrete liquid-vapor streamers and a continuously-varying mixture density distribution shown in an idealization of the Lundholm bearing.

Finally, we offer as Additional References two closely related (and unavoidable overlapping) reports of various applications of the present algorithm.

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