HYDRODYNAMIC LUBRICATION WITH CAVITATION

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In this project we have studied different models for lubrication with cavitation: the classical Reynolds model with strong simplifying assumptions leading to a dimensionally reduced model, and a new Stokes model with cavitation to allow for more general flow patterns.

Cavitation is the disruption of what would otherwise be a continuous liquid phase by the presence of a gas or vapor or both. The phenomenon has been examined by scientists and engineers for a century or more. However it is true to say that the physical understanding of cavitation is still not satisfactory. In tribology, the physical modeling of the cavitation phenomenon is strongly simplified into a condition on the pressure (the pressure cannot fall below the atmospheric pressure). This leads to a variational inequality for the pressure. We have developed adaptive finite element models for solving this variational inequality, both for the Reynolds and Stokes model, as well as for their coupling. [1-3]. In Fig. 1 we show how the cavitation zone is influenced by the channel depth in the case of Stokes flow (we emphasize that the Reynolds model does not allow for large changes in channel depths). We have also developed goaloriented finite element methods, and stabilization mechanisms.

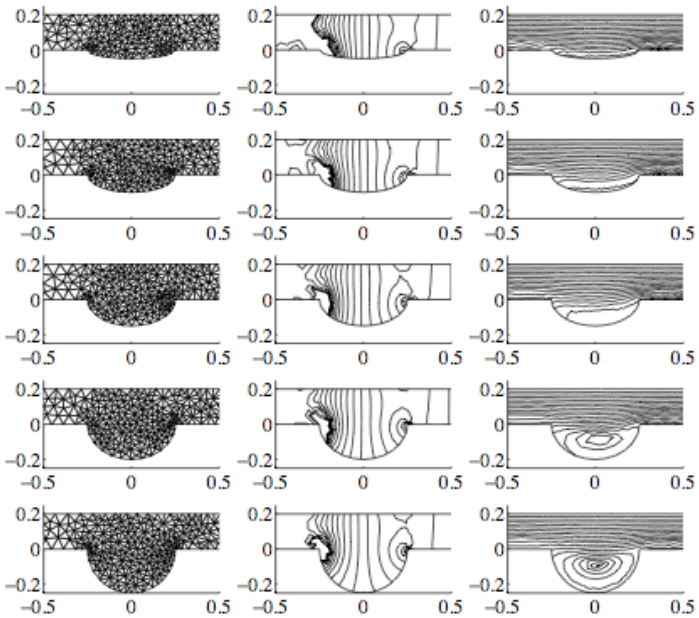

FIGURE 1: Cavitation and recirculation with varying depth using a Stokes model.

References

[1] Nilsson, B. and Hansbo, P., A Stokes model with cavitation for the numerical simulation of hydrodynamic lubrication. (Preprint)

[2] Nilsson, B. and Hansbo, P., Adaptive finite element methods for hydrodynamic lubrication with cavitation, Internat. J. Numer. Methods Engrg. 72/13 (2007) 1584-1604.

[3] Nilsson, B. and Hansbo, P., Weak coupling of a Reynolds' model and a Stokes' model for hydrodynamic lubrication (Preprint)