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CONSERVATIVE FORMULATIONS FOR THE SIMULATION OF FLUID-STRUCTURE INTERACTION IN CAVITATED HYDRODYNAMIC JOURNAL BEARINGS

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Abstract. This talk presents the results obtained through the implementation of a novel model developed from first principles that allows characterizing the pressure field of a liquid–gas lubricant mixture avoiding the reported instabilities with the time derivative of the mixture density. The model is applied to cavitation in hydrodynamic bearings with a focus on accuracy, stability and conservativeness. The formulation also relies on a coupled transport equation describing the evolution of the liquid fraction, ensuring mass conservation. High resolution schemes are used for the spatial treatment of the advection and a temporal discretization based on the Strang splitting method, enabling second-order convergence in both space and time. This model is applied to study cases with gaseous, vaporous or pseudo-cavitation in three state-of-art problems: surfaces texturing optimization, textures and temperature interaction and solid-fluid resonance phenomena. In the first problem changes in depth, shape and quantity of textures are explored to enhance the pumping effect present in Chevron type textures. The texture study also accounts for the simultaneous effects of cavitation and temperature increase due to friction, a topic rarely addressed in the literature. Finally the time evolution of an unidimensional elastic rotor is studied using a coupled Finite Element Method solver in co-simulation with the journal bearing tool to represent the shaft-bearing assembly. Shaft instabilities are triggered by unbalanced discs and masses using linear and non-linear models for the hydrodynamic bearings. The Oil Whirl and Oil Whip instabilities are correctly captured showing the potential of the simulation tool.

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