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A novel algorithm based on variational inequalities to model surface textured contacts with slip at the walls

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Recently, interest in the field of friction reduction has grown significantly. More and more efficiency savings must be made in mechanical systems, as stricter emissions standards are enforced. On the other hand, the miniaturisation of devices, particularly MEMS (Microelectricalmechanical systems) poses an additional challenge. Through the application of new friction reducing technologies, less powerful and smaller motors and pumps are required, meaning that current trends in miniaturisation can be continued.

Experimental and theoretical studies have both shown that, if properly optimised, both surface texture and slip can individually reduce the friction of a system. However, there exists a great deal of uncertainty around the optimisation of surface parameters for both techniques; few reputable experiments have taken place for a limited number of surface parameter values. A fundamental aspect to consider in surface textured contacts is cavitation which can be beneficial on fluid lubrication with helping the lubricant entrainment so reducing friction [1].

In this work we develop a stable and reliable theoretical model based on variational inequalities that can be used to predict surface behaviour when texture, slip, or a combination of the two is applied, with varying surface parameters. Particularly, we couple two different algorithms to predict the formation of cavitation, through a mass-conserving formulation [2], and the presence of slip at the wall [3]. Our model was validated with results found in literature [4]. To show the flexibility of our model several bearing geometries have been analysed, such as a cosine, a double parabolic, a ridge (to mimic an elastic deformed bearing) and a pocket.

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