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LUBRICATED CONTACTS BETWEEN VISCOELASTIC SOLIDS: A NOVEL NUMERICAL STRATEGY

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Lubrication between soft viscoelastic solids has crucial peculiarities that only very recently have started to be investigated by the lubrication science community [1-3]. Indeed, in the last decades, massive research efforts have been dedicated to understand the role of non-Newtonian lubricants, but very little has been done to get what occurs when the lubricated solids are not linearly elastic, but exhibit a different rheology. However, such a topic is acquiring an increasingly marked prominence: all the biological cases, where the so-called soft lubrication occurs, are only examples of situations where the solids into contact cannot be considered linearly elastic.

This work contains an innovative numerical methodology to assess the lubrication regime occurring between a rigid sphere and a linear viscoelastic layer. In detail, an explicit finite difference scheme is coupled to a Boundary Element solver in order to study the viscoelastic lubrication without any limitation in terms of material properties, geometry and viscosity. The results and, specifically, the film thickness, the contact pressure and, ultimately, the friction force show marked differences in comparison with classic lubrication theory. Indeed, we observe that the film thickness minimum moves from the flow outlet to the inlet, where consistently we found a maximum for the fluid pressure. This can be explained only accounting for the actual viscoelastic rheology of the contacting bodies. Finally, we notice that such results have been validated by means of experiments specifically developed to deal with soft matter.

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