Liquid Transfer in Printing Processes: Computational Studies in 2D and 3D

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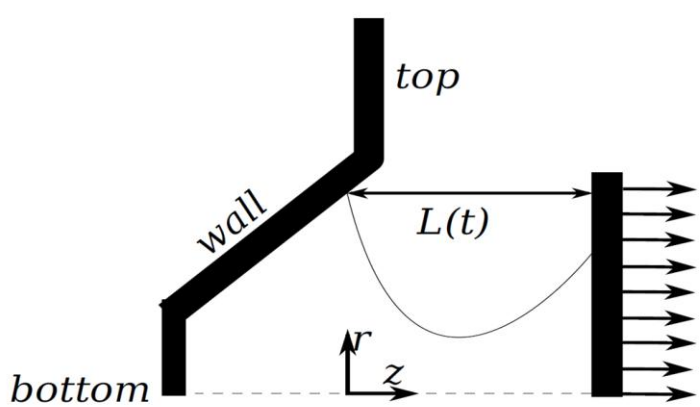
The stretching and breakup of columns of liquid presents a key step in many industrial printing processes, such as gravure or flexography. However, the effects of surface chemistry or topology on the transfer of liquid are not well understood. We use the Galerkin/finite element method (GFEM) to study 2D-axisymmetric liquid bridges that are held between a stationary gravure cell and a flat moving plate. We find that the gravure cell significantly alters the contact line motion relative to that on the flat plate, often causing pinning along the cell wall. In these cases, liquid transfer is controlled primarily by the cell shape, suggesting that the effects of surface topography dominate over those of surface wettability. We also compared our results to Rayleigh's stability limit for static cylinders and found that the deviation from this limit appears to depend on the contact line pinning, and not directly on any geometric factors or the combination of contact angles studied. Finally, we present preliminary results using a 3D GFEM code to study the stretching of liquid bridges with fixed contact lines.



Schematic of the trapezoidal cavity used in this work