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A Computational Approach for Capturing Topological Changes during the Splitting of Liquid Plug by a Pulmonary Bifurcation BENJAMIN VAUGHAN, University of Cincinnati, JAMES GROTBERG, University of Michigan — There are certain medical treatments that involve the introduction of exogenous liquids in the lungs. These liquids can form plugs within the airways that may then propagate throughout the branching network of the lungs. The propagation through the pulmonary branches can cause the liquid plugs to split. The understanding this splitting process is important for effective administration of various treatments such as surfactant replacement therapy. A significant complication in modeling the splitting process is the possibility of a topological change where the two air fingers defining the leading and trailing meniscus split into a topologically distinct configuration that consists of two liquid plugs bounded by three air fingers (one trailing and two leading). To study this process, we introduce a two-dimensional computational model that captures the propagation and splitting of a liquid plug along with the topological changes. This model consists of a finite element solver coupled with a narrow band level set approach for tracking the air/liquid interface and is shown to be efficient in capturing the full splitting process and allows for the estimation of the ratio of the resulting plugs to each other after the original plug has been split.

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