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Using DNS and Statistical Learning to Model Bubbly Channel Flow[1] MING MA, JIACAI LU, GRETAR TRYGGVASON, University of Notre Dame — The transient evolution of laminar bubbly flow in a vertical channel is examined by direct numerical simulation (DNS). Nearly spherical bubbles, initially distributed evenly in a fully developed parabolic flow, are driven relatively quickly to the walls, where they increase the drag and reduce the flow rate on a longer time scale. Once the flow rate has been decreased significantly, some of the bubbles move back into the channel interior and the void fraction there approaches the value needed to balance the weight of the mixture and the imposed pressure gradient. A database generated by averaging the DNS results is used to model the closure terms in a simple model of the average flow. Those terms relate the averaged lateral flux of the bubbles, the velocity fluctuations and the averaged surface tension force to the fluid shear, the void fraction and its gradient, as well as the distance to the nearest wall. An aggregated neural network is used for the statistically leaning of unknown closures, and closure relationships are tested by following the evolution of bubbly channel flow with different initial conditions. It is found that the model predictions are in reasonably good agreement with DNS results.

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Ming Ma
University of Notre Dame

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