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Numerical Simulation of Turbulent Bubbly Flow in a Vertical Square Duct PRATAP VANKA, PURUSHOTAM KUMAR, KAI JIN, University of Illinois at Urbana-Champaign — We numerically investigate the dynamics of a large number of gas bubbles in a turbulent liquid flow in a confined vertical square duct, a problem of interest to many industrial equipment. The fluid flow is simulated by Direct Numerical Simulations and the motions of the bubbles are resolved by an accurate Volume of Fluid (VOF) technique. The flow is considered periodic in the streamwise direction with an imposed pressure gradient. The surface tension force is incorporated through a Sharp Surface Force (SSF) method that is observed to generate only very small spurious velocities at the interface. The algorithm has been programmed on a multiple-GPU computer in a data parallel mode. The turbulence driven secondary flows are first ensured to agree with previous DNS/LES by other researchers. A very fine grid with 192 x 192 x 768 control volumes is used to resolve the liquid flow as well as 864 bubbles using 12 grid points across each bubble in all directions. The computations are carried out to 1.5 million time steps. It is seen that the bubbles preferentially migrate to walls, starting from a uniform layout. We present instantaneous and time mean velocities, turbulence statistics and compare them with unladen flow as well as with a bubbly flow in a planar channel.

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