Computational Multiphase Flow

Project Tasks

1. Steady fully-developed single-phase channel flow (same for all groups)

Develop a routine to compute the velocity in a steady fully-developed single-phase channel flow with variable viscosity, using the finite-volume method. Assume that the viscosity profile is a prescribed input to the routine. Consider three possible wall boundary conditions: *(i)* prescribed velocity at the wall, *(ii)* prescribed velocity-gradient at the wall, and *(iii)* prescribed relation between the shear-stress at the wall and the velocity field. Consider two possible global boundary conditions: *(i)* prescribed pressure-gradient and *(ii)* prescribed flow-rate.

2. Turbulence models (same for all groups)

    a) Develop a routine to compute the eddy-viscosity Prandtl mixing-length model, with prescribed functions for the mixing-length (try different functions). Incorporate this routine into the channel flow code.

    b) Develop a routine to compute the eddy-viscosity using the k-epsilon model, and incorporate this routine into the channel flow code. (Note: this item is optional; it is much more complex than the previous and you will probably need further guidance).

3. Wall functions (same for all groups)

    a) Develop a routine to use a log-law wall-function as the prescribed relation between the shear-stress at the wall and the velocity-field. Consider the possibility of both smooth and rough walls. Incorporate this routine into the channel flow code.

    b) Adapt the k-epsilon model routine to the use of the wall-function of the previous item, and incorporate it into the channel flow code. (Note: this item is optional and you will probably need further guidance).

4. Unsteady fully-developed single-phase channel flow (same for all groups)

Modify the previous tasks in order to develop a routine for unsteady flow. Assume that the turbulence models and wall functions are the same as for the steady situation, but considering the instantaneous velocity field (“quasi-steady equilibrium”). Consider two possible global boundary conditions: (i) pressure-gradient a prescribed function of time, and (ii) flow-rate a prescribed function of time.