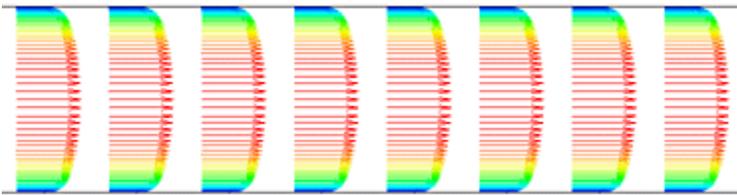


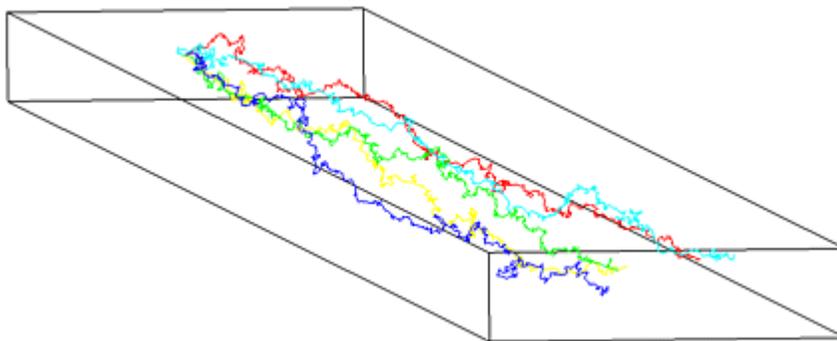
Turbulent Particle Tracking

In this application we explore the capabilities of AcuSolve's turbulent particle tracking technology. The flow solver is used to obtain a steady Eulerian flow field with a RANS turbulence model (typically the one-equation Spalart-Allmaras model). The Lagrangian particle tracker is used in a post-processing mode to follow the paths of any number of massless particles. For laminar flows the particle paths are parallel to the local velocity and are thus all identical if their initial conditions are identical. For turbulent flows, the eddy viscosity field is used to create a different Weiner process for each particle. This process simulates particle dispersion by a real unsteady 3D turbulent flow.

As a simple example a fully-developed channel flow at a Reynolds number of 100,000 is solved. The length and width of the channel are 100 and 4 channel heights, respectively. Shown below are the velocity vectors colored by the magnitude of the eddy viscosity for a short section of the channel.

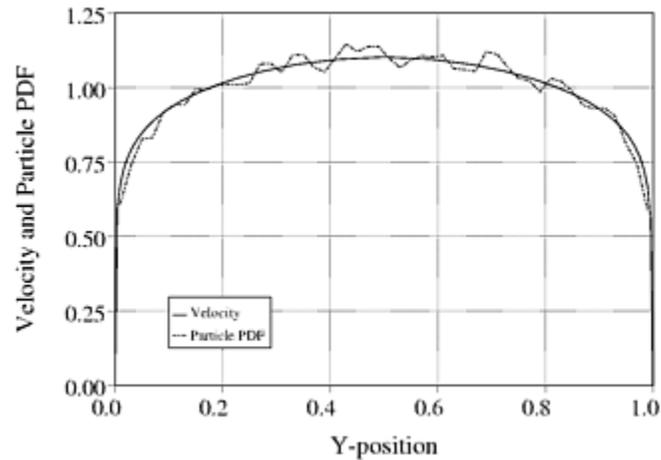


In the following, particles are released at the center of the inlet surface. Here the paths of 5 particles are shown. They start together on the left and follow different paths until they exit on the right.



A PDF (Probability Density Function) of the vertical (y) location of the particles as they leave the channel is plotted below. In order to get good statistics one million particles are tracked, which requires 45 minutes on a 4-processor workstation. Conservation of mass in the Lagrangian sense is equivalent to this PDF converging to the normalized mean velocity profile as the number of particles and the length of the channel both approach infinity. For a small number of

particles or a channel length/height less than about 50, the good agreement seen below is not achieved. Clearly, the particle tracking algorithm must be both fast and accurate to be of practical value.



200 particle paths in the streamwise/spanwise plane are shown below. Note how the particles initially disperse quickly, then slow down. The standard deviation of the spanwise particle locations roughly follows the expected square-root behavior, although there is some dependence on the vertical coordinate.

