scs46

Steve Southern's Individual Contribution Page

Fall 2009 Mid-Semester Contributions

This semester was spent doing flocculator simulation work in an attempt to model the flow far from the inlet where conditions become steady. The goal was to obtain a full flow description so the performance of a particular flocculator geometry could be understood. I worked on two different methods to achieve this result. A large amount of time was spent trying to implement a periodic boundary condition case which has the specific purpose of modeling fully developed phenomena far from inlet effects. I worked to create a geometry and mesh that were compatible with the requirements FLUENT puts on its periodic solver and to set up the physics and solution methods such that a converged solution could be obtained. The second approach involved increasing the number of baffles to a number never tried before and letting the computer take its time to solve a mesh containing ~10^5 cells. The first method can now essentially be discarded as not worthwhile. Despite the simplicity of the model (fewer cells, fewer required boundary conditions), there was no solution to this case because variables had to be streamwise periodic. The many-baffle set up seems far more promising. It only takes about ten baffles to get the sort of flow consistency that we were looking for with the periodic case. I was able to examine these results and for the last few baffles, the pressure drops become constant and energy dissipation rates are uniform at a specified y point across each turn. I also wrote a simple MATLAB code that converts old Gambit journal files for geometry and meshing to the new workbench format so that work done in previous years can be easily modified and serve as a foundation for future simulations.

Fall 2009 Post Mid-Semester Contributions

I spent a good part of the remainder of the semester performing a somewhat tedious verification and validation of our numerical results. In previous years, there had been little done to quantify the error associated with mesh size and iterative convergence. Further, the work done to select the turbulence model may not have been sufficient to make a correct decision. For grid convergence, I did a systematic examination of pressure coefficient drop across many baffles for three different mesh densities to determine the percent difference for each refinement. I also confirmed work that had been done on near-wall mesh grading since this was needed to properly resolve the boundary layer. Iterative convergence was an easier task as the difference between convergence to 10^-6 and 10^-9 was very small. For validation, there was concern that the k-epsilon realizable turbulence model wasn't accurately modeling flow around a 180 degree bend. Despite comparison to the well-studied benchmark of flow over a back step, CFD pressure coefficient drop was ~3.9 while that from experiment was ~2.3. I looked at two other models that hadn't been used on the flocculator (Spallart-Allamas and Reynolds Stress) to see if they better predicted pressure coefficient drop. I also worked to make determinations for each h/s value (2,3,4,5,8,10,15,20,40) of how many baffles were needed for the flow to become baffle-wise periodic. This work and that on turbulence model selection are still in progress and will proceed into next semester. Finally, I extensively revised and reprogrammed the data extraction UDFs to calculate performance parameters in more efficient and common sense way. With these UDFs we've been able to look at parameters like K_baffle and collision potential. They are set up for very general cases, so only one small modification needs to be made for any geometry change.