LES in a U-Bend Pipe Meshed by Polyhedral Cells

Large Eddy Simulation of an incompressible fluid in a straight pipe with a circular cross-section is investigated with a Finite Volume (FV) method based on polyhedral cells, using synthetic turbulence at the inlet. Results of this non-periodic simulation are quite accurate after 2 diameters from the inlet, showing that the structures are self-sustainable. The method is then extended to a flow in a 180? U bend pipe with circular cross-section, using an original automatic and boundary-layer-adapting meshing technique. This configuration, or a more convoluted version of it, is often encountered in industry (e.g. in car engines, air-conditioning, etc) and could not be regularly and smoothly meshed by cylindrical grids. The Reynolds number based on the bulk velocity and the hydraulic diameter is in both cases equal to 54,700. Comparisons are made with the experimental results from Azzola et al. (1986). Success of the simulation is mostly due to the excellent properties of the FV scheme on polyhedral cells. The fact that lines connecting cell centres are nearly orthogonal to the cell faces ensures that the numerical scheme is virtually free from any numerical diffusion. This was demonstrated on an array of 2-D inviscid vortices which are self sustained without loss of intensity.

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