EXTENSION OF SPECTRAL/FINITE ELEMENT CODE FOR LARGE EDDY SIMULATIONS (SFELES) TO AXISYMMETRIC BODIES

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A non negligible part of the flow resolution in Fluid Dynamics is done using computational codes. Computational Fluid Dynamics (CFD) is studying a long time ago the different discretization techniques deriving the partial differential equations into algebraic relations relating the flow variables at some points. Since the beginning, a lot of schemes have been studied to see the difference between the relations obtained with various discretization techniques.

The code written in this project try to take the advantage of 2 discretization techniques : the finite element method and the spectral development for the resolution of flows around axisymmetric bodies. Without going into details, we use spectral development in the azimuthal direction, while each mode is modeled using finite lement discretization in the (z,r) plane. This technique has the main advantage of decoupling the various equations governing each mode from the others. In this sense, the computation can be done faster, because we are facing to the resolution of a set of uncoupled 2D problems for each mode, which is quite easier on the numerical point of view than a full 3D system. The main drawback, is the fact that we can compute the flow only around axisymmetric bodies, even if the flow computed is fully 3D.

Even if this restricts the generality of the code, a wide range of practical problems can be computed with this code : flow around a capsule during the last phase of reentry, near the landing, when the velocity is sufficiently low, full turbulent flow in a pipe.

In the present project, the code has been build and tested on various problems where analytical or experimental solutions exist. The results look quite promising even if some additional test cases should be helpful for a correct evaluation of the code in non-axisymmetric mode.

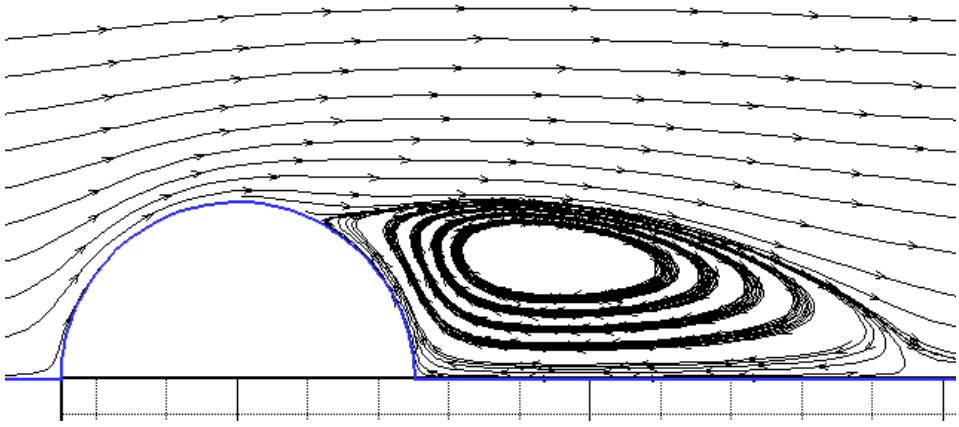

Figure 1 : Flow around a sphere at Re=200

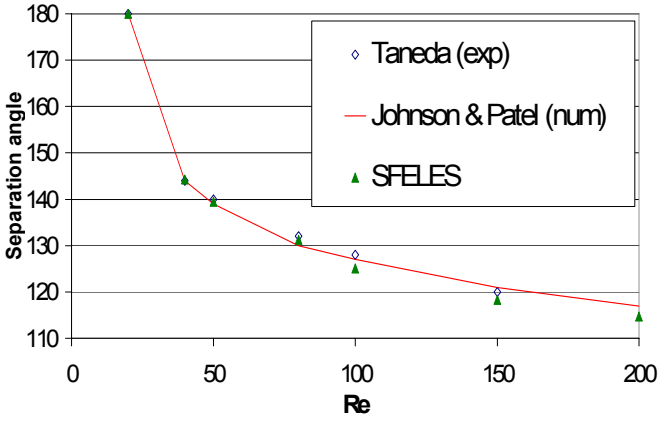

Figure 2 : Comparison numerical and experimental results