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MCI-B REPORT

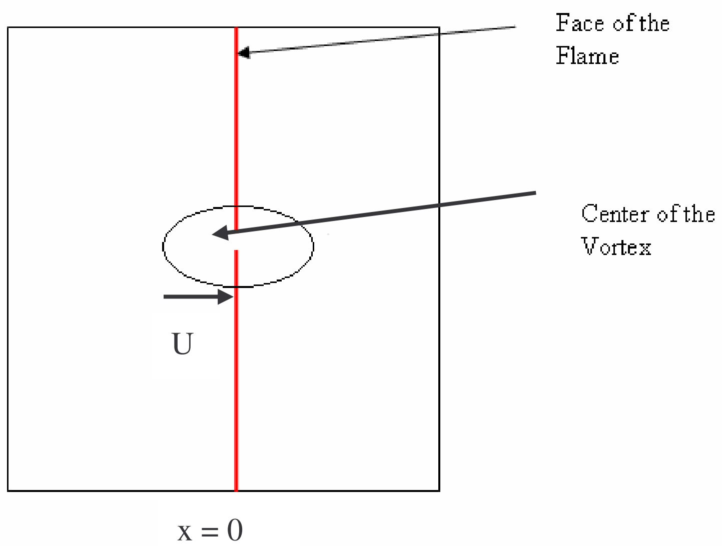
Use of AVBP code

INTRODUCTION

The aim of this report is to study the interaction between a vortex and a flame with the software AVBP. This simulating code from CERFACS solves compressible Navier-Stokes equations in 2D or 3D structured and unstructured meshes.

This solver is well adapted to combustion. The prediction of these unsteady turbulent flows is primarily based on the LES (Large Eddy Simulation) approach. The numerical analysis needs a mesh from Hip .In this study we put interest in a laminar case where a vortex is added on a premix flame.

I. GEOMETRY



L = 0,1556 m

Vortex

Initial position : x=0 m ; y=0 m

radius : 0,01 m

strength : 0,5

Flame CH4 flame/premix

Initially the flame is vertical and positionned at x=0

flame speed : Sl = 0,3419 m/s

In order to keep the flame at the same position we will take U = Sl

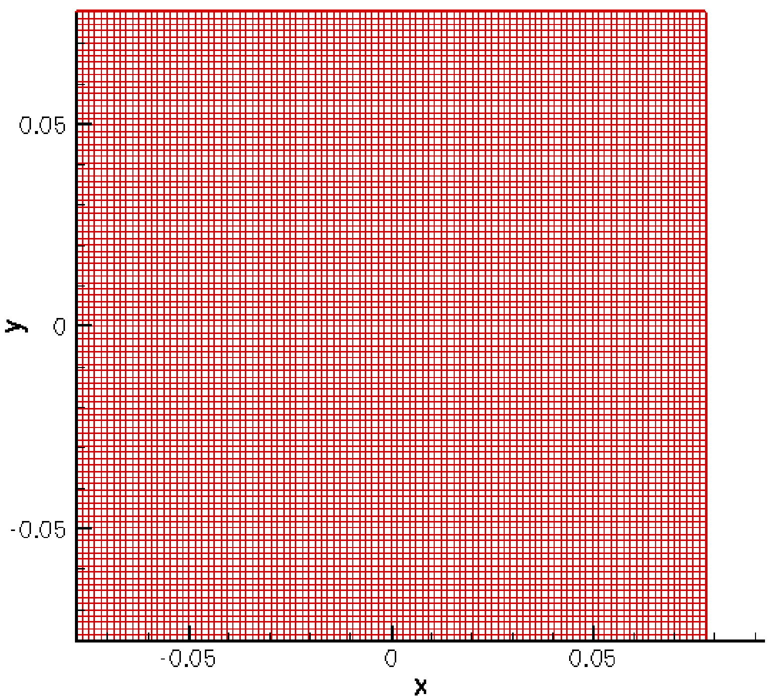
II. MESH AND BOUNDARIES CONDITIONS

The mesh is a grid 100*100.

dx=dy=1,56 mm

Symmetry

Inlet



Outlet

Symmetry

AVBP V5.4 Boundary conditions

Inlet:	u, T, Y non reflect.	INLET_RELAX_UVW_T_Y
Outlet:	P, non reflect.	OUTLET_RELAX_P
Top boundary	Symmetry	SYMMETRY
Bottom boundary	Symmetry	SYMMETRY

III. INITIALISATION

A non stationary calculation 2d is carried out in LES (Large Eddy Simulation) mode

1. SPECIES

5 chemical species

'CH4' 0.666

'O2' 0.770

'CO2' 0.981

'H2O' 0.637

'N2' 0.813

2. REACTION

CH4+ 2 O2=>CO2+2 H2O

IV. RESULTS

The results are obtained afer 50000 iterations

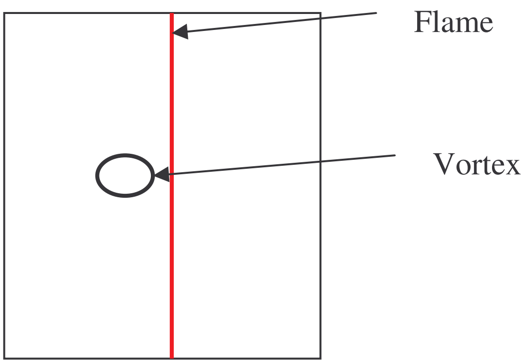
1. First Results

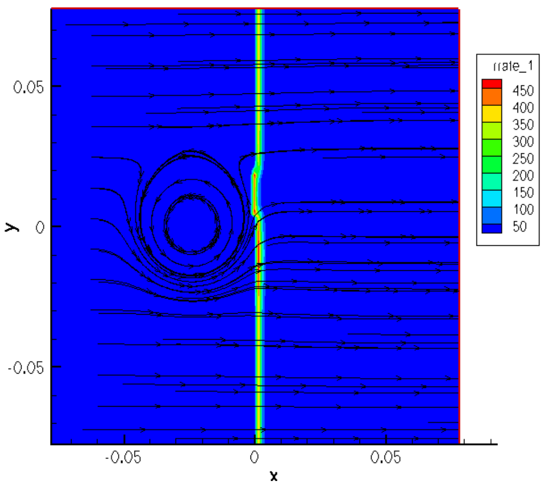
The first result was obtained with a vortex centred on 0,0.we don't have div ρU = 0 because of a source term that's why there are some acoustics waves. As a consequence the pressure increases quickly. To avoid this trouble there are several solutions :

- To minimize U in the part where gases are hot.
- To shift the vortex

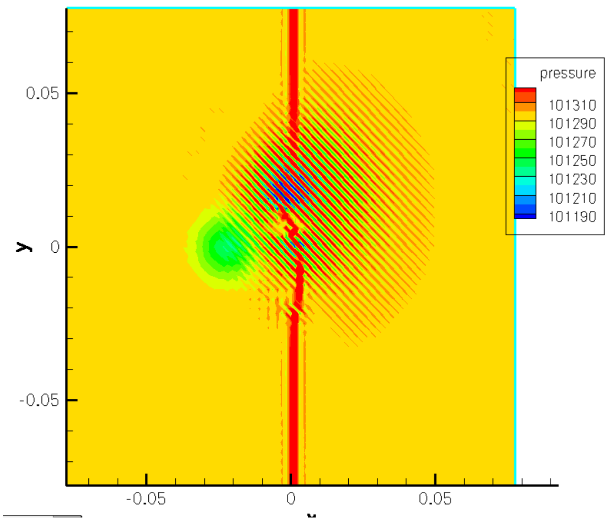
I have chosen the second solution.

The following results are obtained with a vortex positionned on x= -0,025 m





Even if we have been careful we did not solve the problem concerning the acoustic waves .Indeed we can see some perturbations on the pression figure.



2. Study of flame thickening.

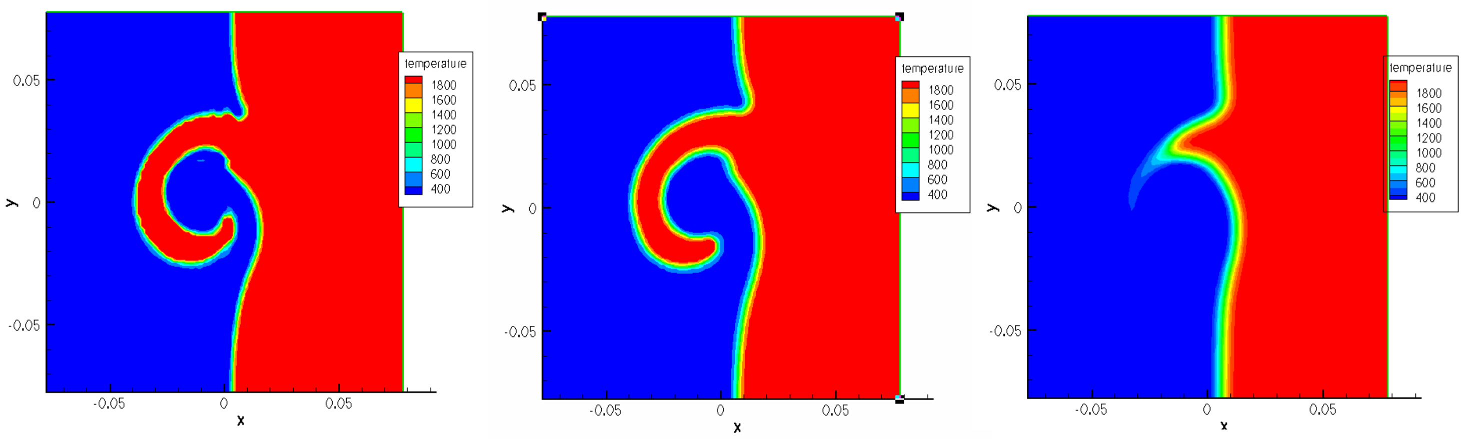
In this part of the study the thickness of the flame has been changed in order to see its influence on interactions between flame and vortex

Let us recall that two nodes are separated by 1,56 mm

Comparaison of the evolution of temperature according to flame thickning

flame thickness

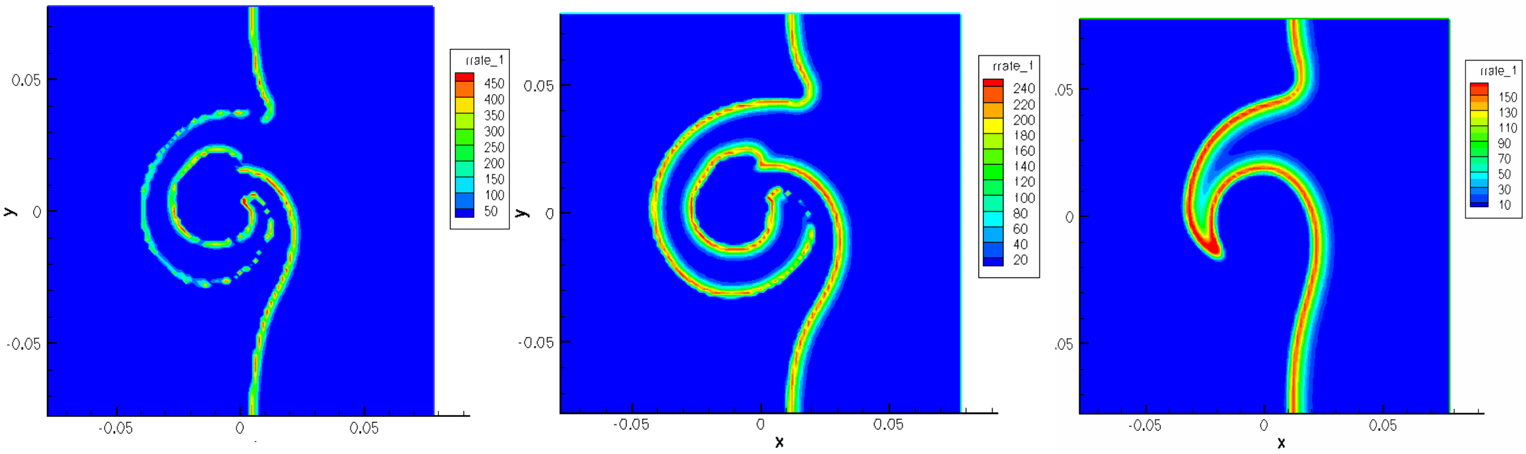
5 mm 10 mm 15 mm



Comparaison of reaction rate according to flame thickning

flame thickness

5 mm 10 mm 15 mm



I did not solve the problem of the explosion of pressure .As a result all the simulations were stopped closed to 50000 iterations.The thicker is the flame the more stable it is . Indeed at the end of the same iteration count the thicker is the flame the less change in form there is.

Moreover if a flame is thick there are few possibilites for it to become discontinuous

CONCLUSION

The work done with AVBP allowed me to take the code in hand and to realize the importance of meshing and boundary conditions on a solution.

In fact a small part of the capabilities of the code is used here. A further step could be to use deeply the parameters of the code. Because of a long adaptation time, I was unable to make such investigations.