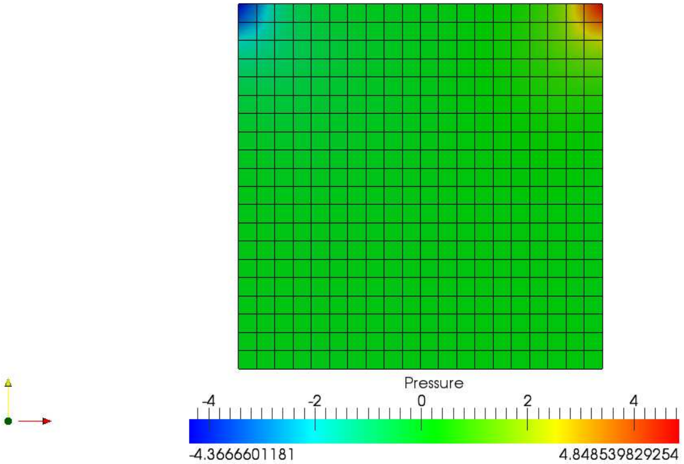
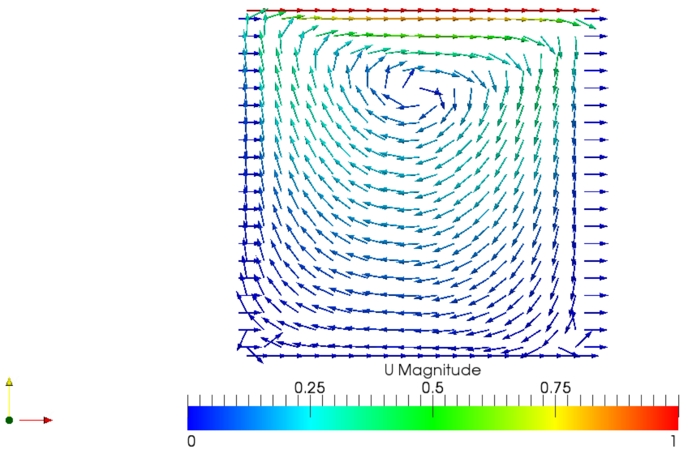
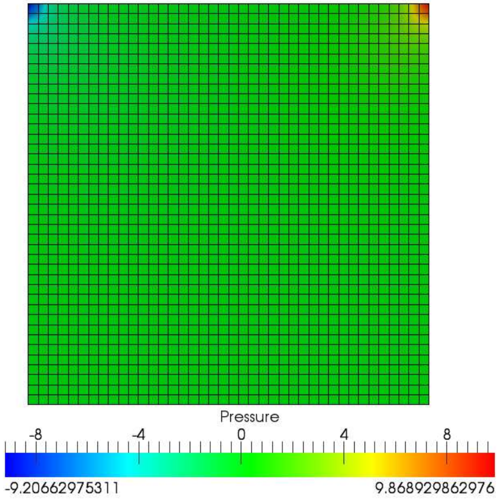
Cavity case

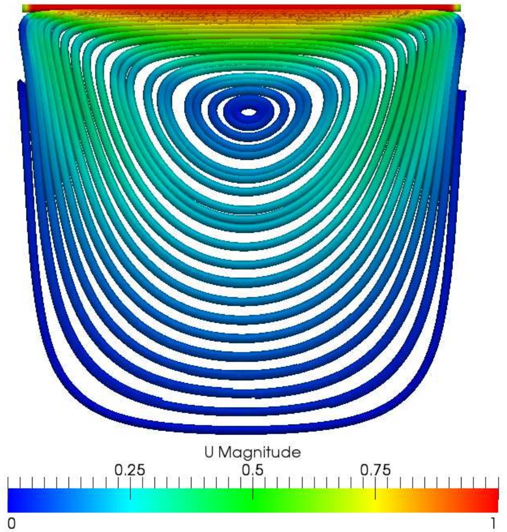




- The left figure shows the mesh and pressure distribuition in the cavity case. In paraFoam this is achieved using the display option ”Surface with edges”.
- The right figure is colored by the velocity magnitude. To further describe the fluid motion the velocity field is plotted by vectors.
- To plot vectors two filters are used in paraFoam. First ”Cell centers” followed by ”Glyphs”.

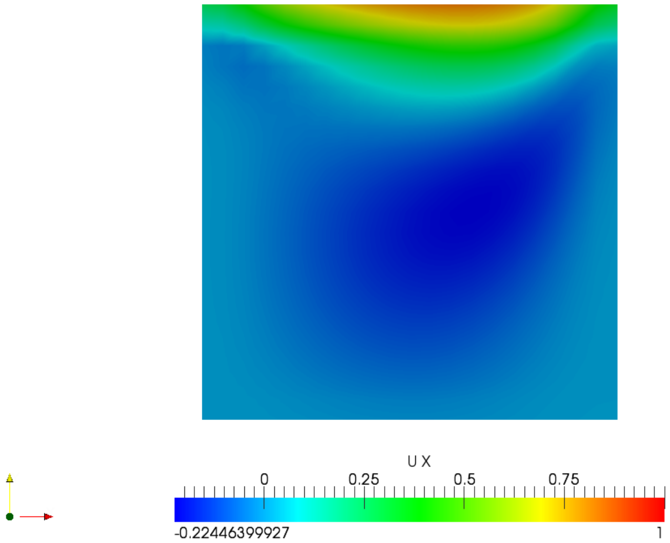
Cavity case using fine mesh

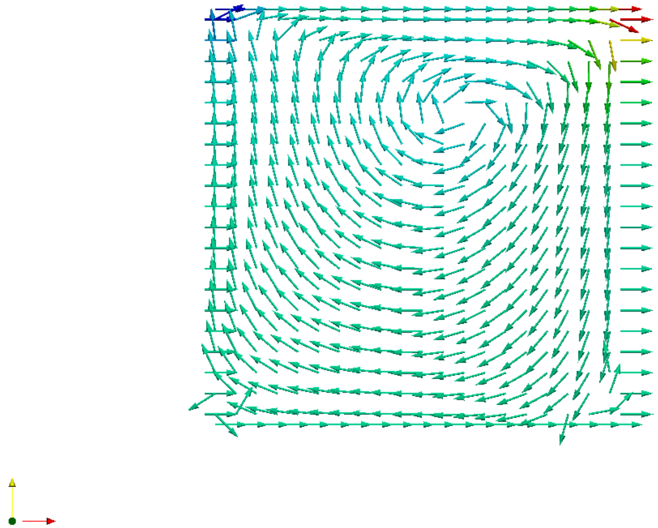




- Similar as the previous slide the left figure shows the mesh and pressure distribuition. Notice the finer mesh.
- The right figure is colored by the velocity magnitude. Streamlines are used to further visualise the results.
- Stream lines are created using the "Stream tracer" filter. The filter "Generate tubes" is used to enhance the streamlines.

Cavity case using high Reynolds number



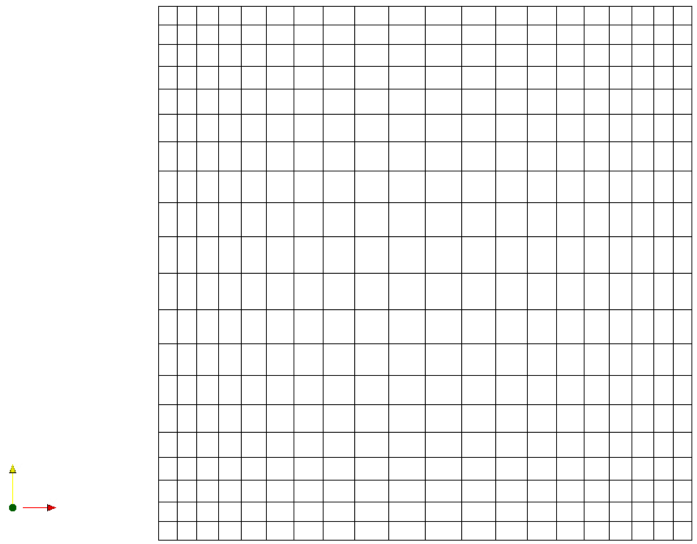


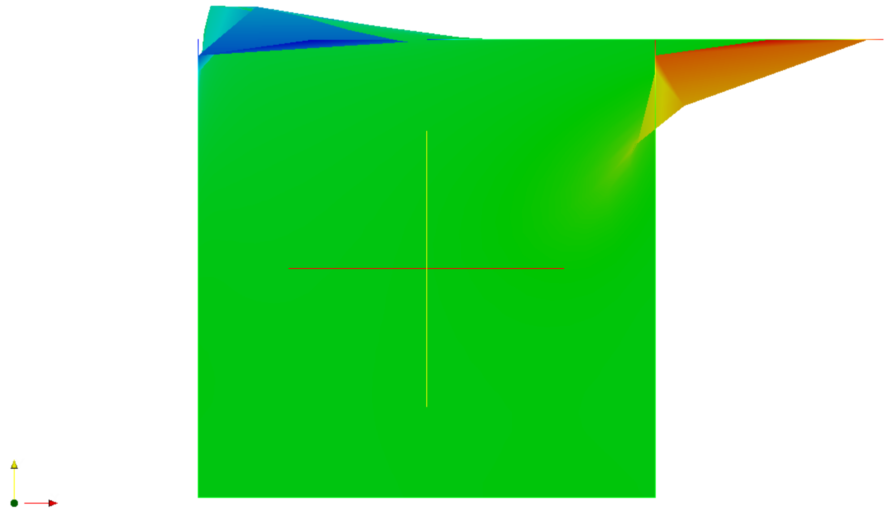
- In the left picture the velocity magnitude in the x direction is shown.
- The velocity field Ux is found using the foamCalc utility.
- Run the following command:

```
foamCalc components U
```

- The right picture shows the velocity vectors.

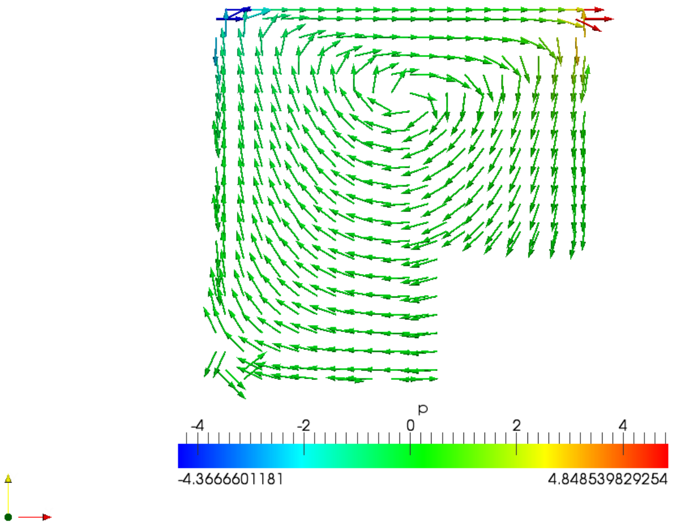
Cavity case with graded mesh





- The mesh has now been graded. This is shown in the left figure using the ”Wireframe” display option.
- A filter called ”Warp by vector” is used in the right figure to describe the velocity.

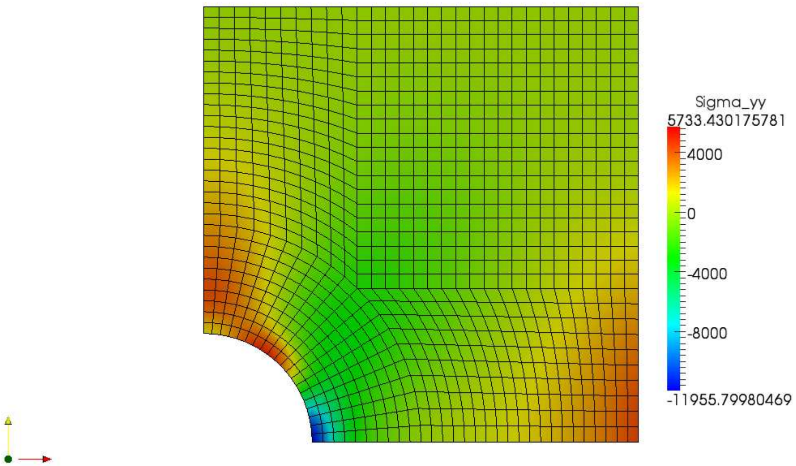
Cavity case with clipped geometry

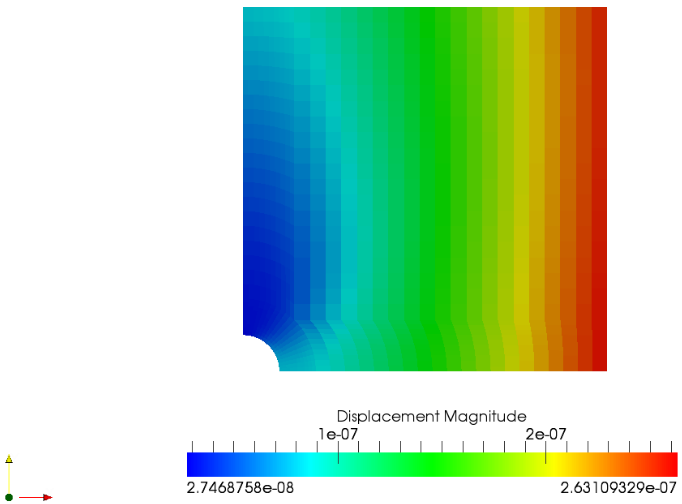


- The new geometry simulation was started with inital values from the original cavity case. This is obvious from the velocity vectors for the first time step. See the left figure.

- The stream lines shown in the right figure are from the last time step.

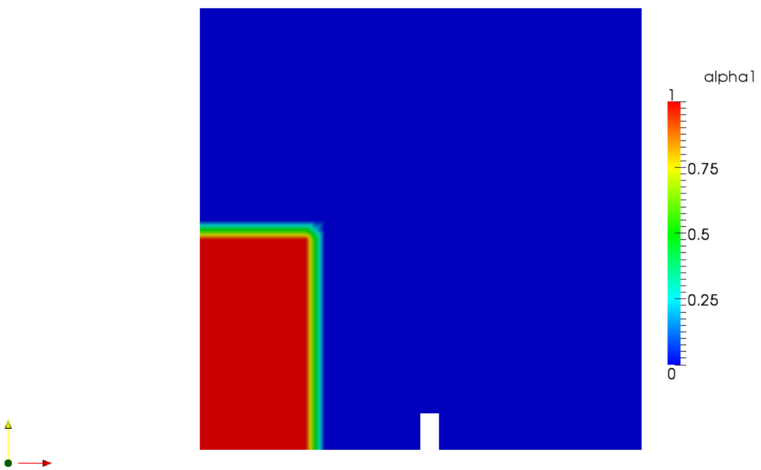
Plate hole case

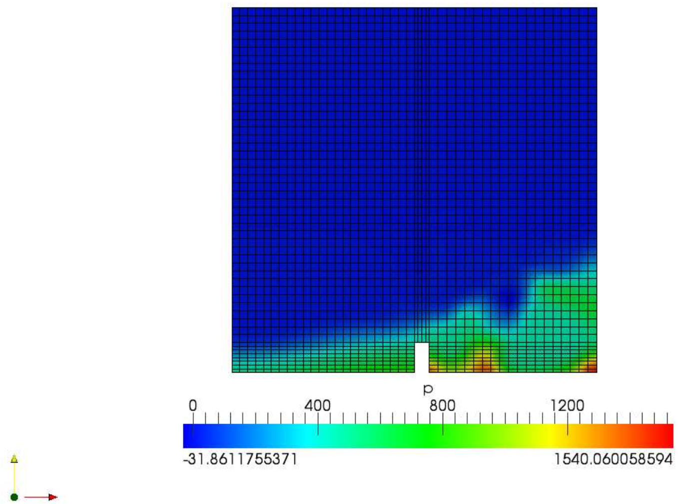




- In the left figure the stress in the yy direction is shown together with the mesh.
- To the right the displacement is shown without graphical smoothening between the cells. Here the plate size has been increased with a constant size of the hole.

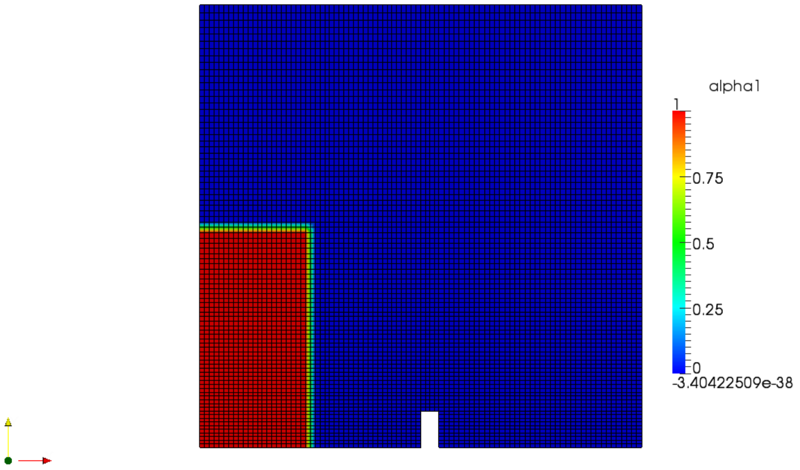
Dam break case

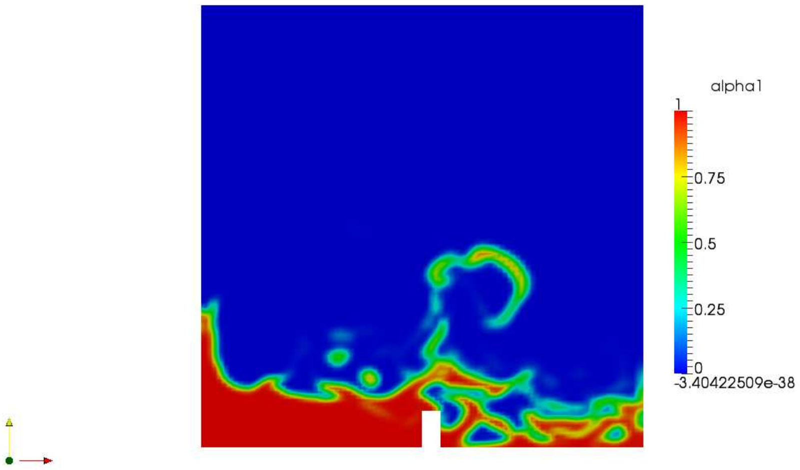




- Alpha 1 for the inital state in the dam break case is shown to the left.
- In the right figure alpha 1 is plotted at the end of the simulation with the coarse mesh.

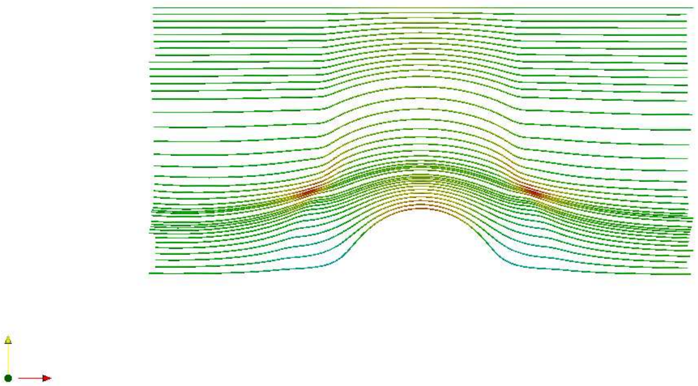
Dam break case using fine mesh

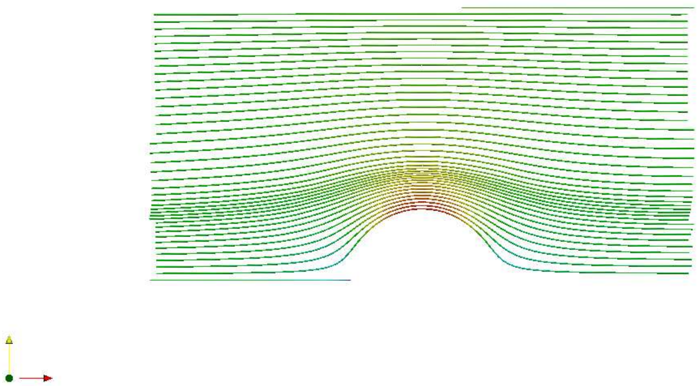




- Alpha 1 is shown at the inital state together with the finer mesh to the left.
- Alpha 1 half way through the simulation. See the right figure.

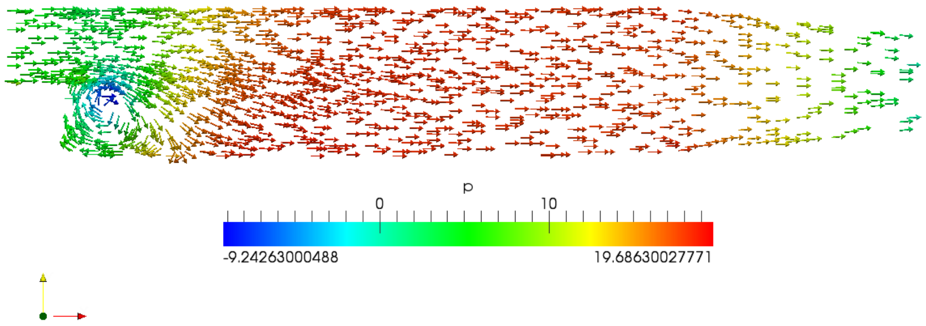
Cylinder case

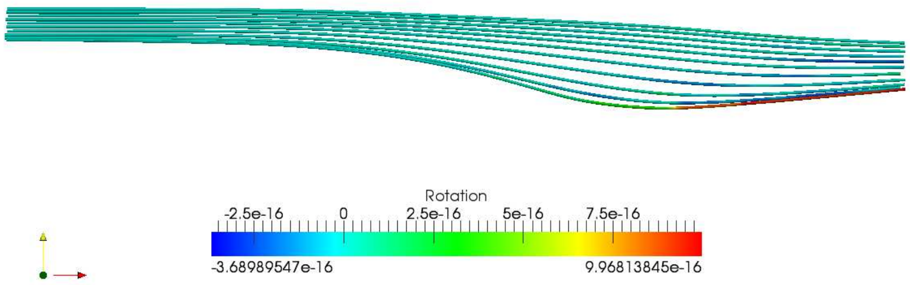




- These figure shows stream lines for the cylinder case.
- To the left without non orthogonal correction and to the right with correction.

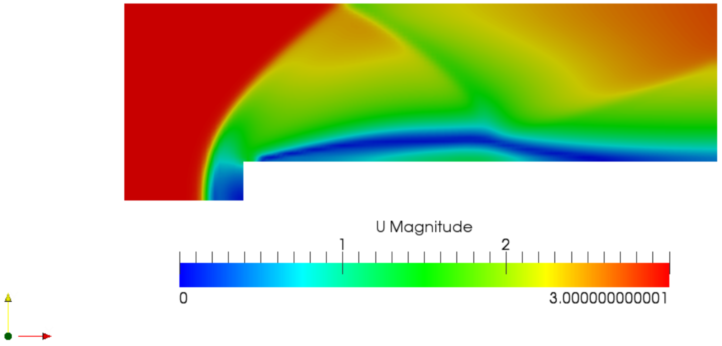
Pitz and Daily case

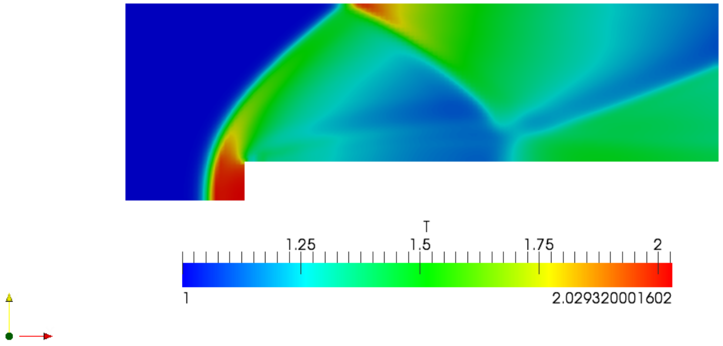




- In the left figure velocity vectors for the Pitz and Daily are shown.
- The right figure is created using the ”Stream tracer” and ”Genrate tubes” filters to show the rotation.

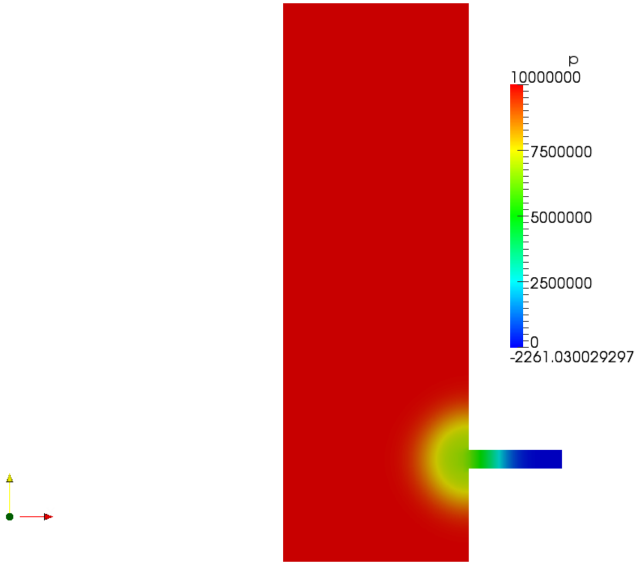
Forward step geometry case

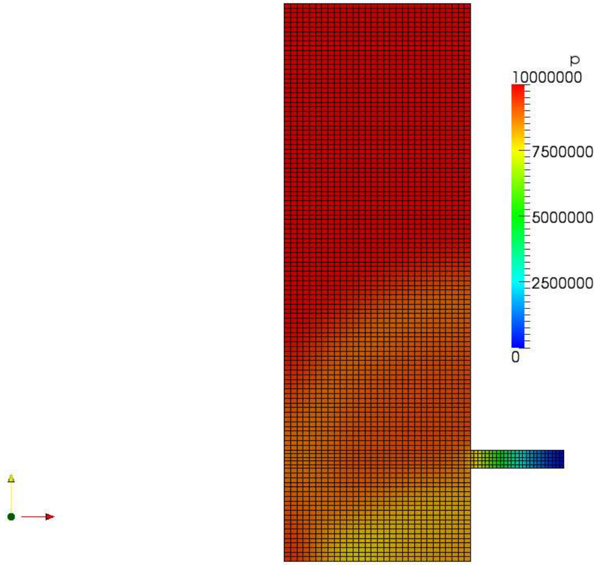




- In this case the flow is supersonic. Hence shock waves are present. These are obviuos from the speed and temperature figures.

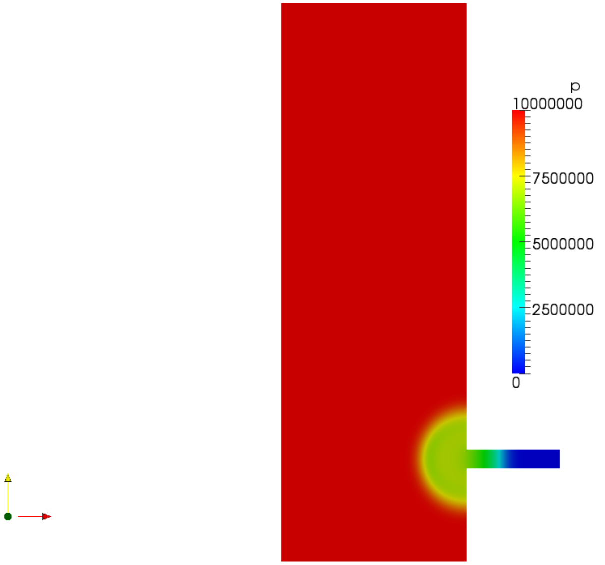
Decompression tank case

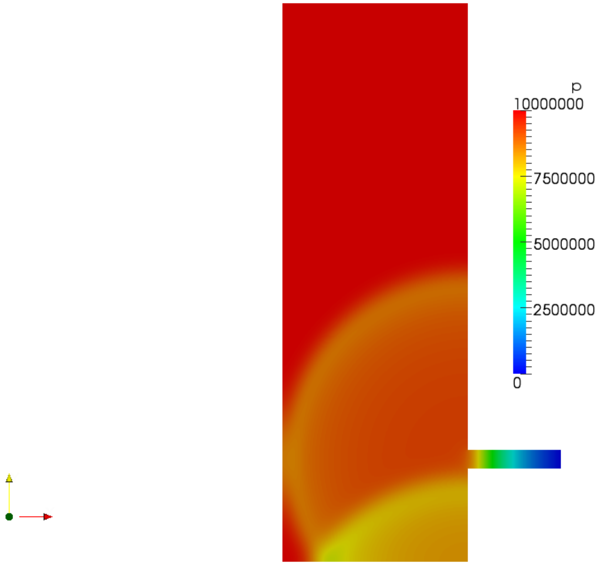




- In this slide the pressure is displayed for two stages as well as the mesh.

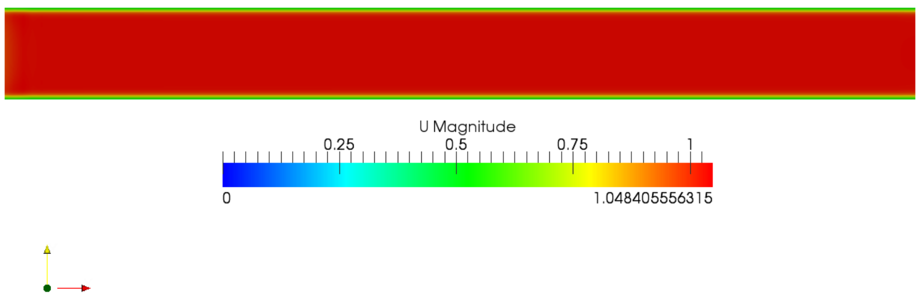
Decompression tank using fine mesh

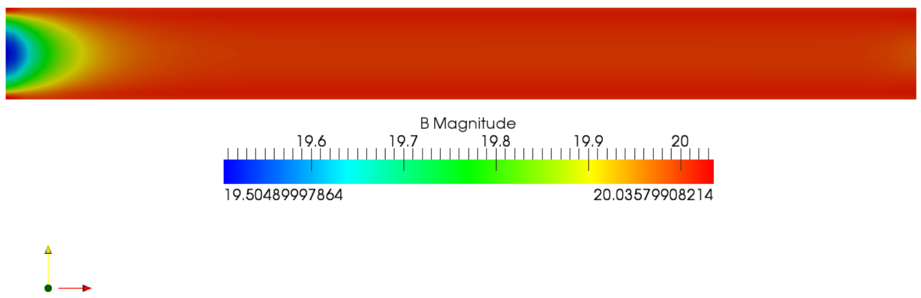




- These figures shows the pressure at the same to stages as in the previous slide. Now the mesh resolution has been increased.

Hartmann case

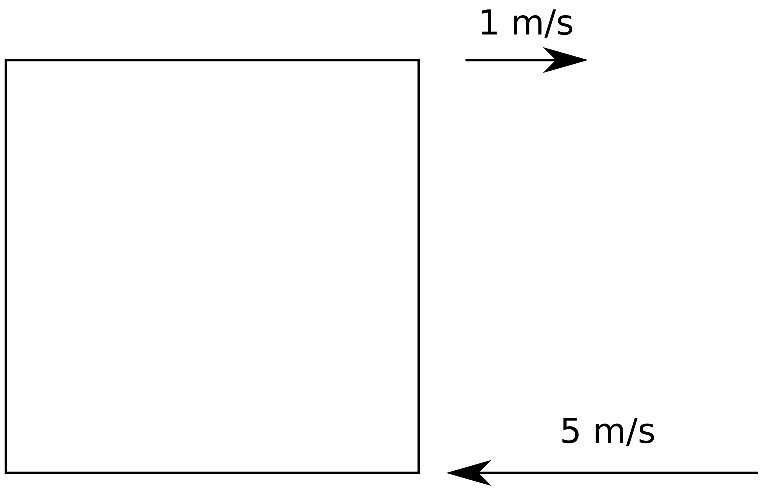




- To the left the velocity as the conducting fluid flows through the magnetic field.
- To the right the magnetic flux density is shown.

The modified cavity case

- Here follows a moification of the cavity tutorial.
- In this case both the upper and lower patch is moving. The upper moves similar as in the original case, 1 m/s to the right. The lower moves in the opposite direction at a speed of 5 m/s.



Mesh modification

- The mesh patches must be redefined to allow the lower lid to move. The patch definintion in the now modified blockMeshDict look like this:

```
patches
(
    wall movingWall
    (
        (3 7 6 2)
    )

    wall lowermovingWall
    (
(1 5 4 0)
    )
    wall fixedWalls
    (
        (0 4 7 3)
      (2 6 5 1)
    )
```

```
        empty frontAndBack
        (
            (0 3 2 1)
            (4 5 6 7)
        )
    );
```

p and U definition

- In the 0/p file the new patch, lovermovingWall, must be added. This patch will have the same properties as the upper lid.
- The 0/U file also needs the new patch. Especially since the speed is defined here. The 0/U file:

```
dimensions      [0 1 -1 0 0 0 0];

internalField   uniform (0 0 0);

boundaryField
{
    movingWall
    {
        type            fixedValue;
        value           uniform (1 0 0);
    }

        lowermovingWall
```

```
    {
type fixedValue;
value uniform (-5 0 0);
    }

    fixedWalls
    {
        type            fixedValue;
        value           uniform (0 0 0);
    }

    frontAndBack
    {
        type            empty;
    }
}
```

Boundary definition

- Boundaries are defined in the constant/polyMesh/boundary file. Here the new patch must be defined.
- It is required to study the points and faces files to find out the numbering of the startFaces, i.e a previous cavity case must have been runned.
- A comparison with the original boundary file is recommended. Notice the ”4” in the top of the new boundary file.

```
4
(
    movingWall
    {
        type            wall;
        nFaces          20;
        startFace       760;
    }
    lowermovingWall
    {
```

```
        type            wall;
        nFaces          20;
        startFace       780;
    }
    fixedWalls
    {
        type            wall;
        nFaces          40;
        startFace       800;
    }
    frontAndBack
    {
        type            empty;
        nFaces          800;
        startFace       840;
    }
)
```

Courant number and results

- In order to keep a Courant number below 1 the time step has to be reduce. In the system/controlDict timeStep is set to 0.001. I.e a fifth of the original since the larger velocity is five times higher.

- A couple of figures from the new case: