

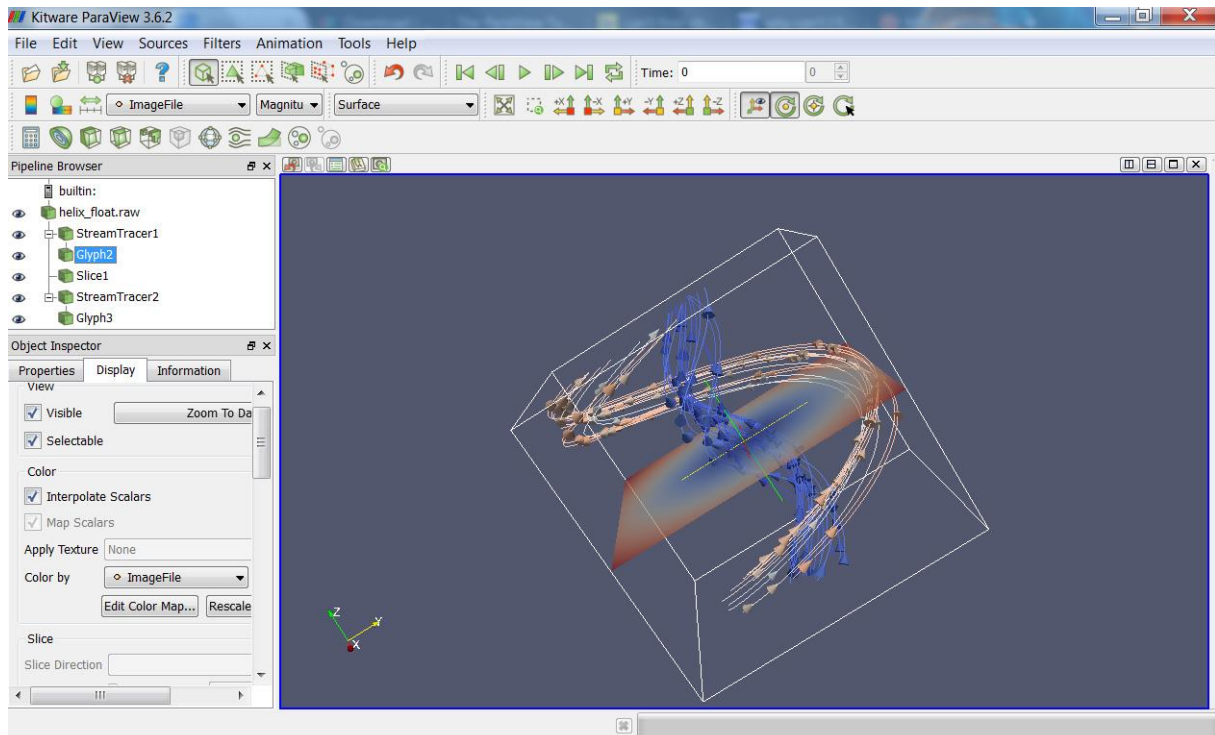
DH2320 - Lab 5

Introduction to 3D visualization

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Written report

1 - Vector Field



1 - Vector field representation: two streams and a Z-slice

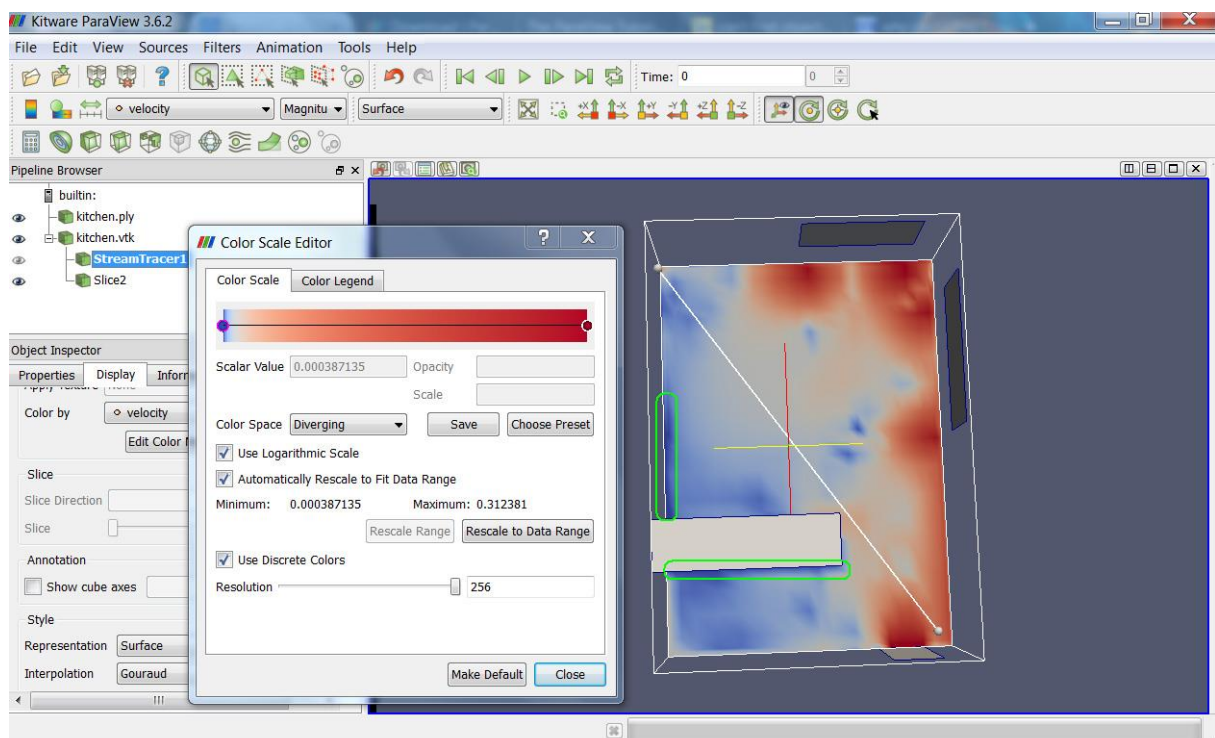
This ParaView screenshot represents the vector field with:

- A stream that shows the helicoid-shaped path of a seed launched far from the central axis ($X=0, Y=0$). The beige color shows that the velocity is higher than in the central blue stream. The flux is oriented along the Z axis, towards positive values. The radius of the seeds seems to be kept constant.
- A stream that shows the same shape but with seeds launched close to the central axis. The radius seems to be constant here as well. The blue color shows that the amplitude is smaller than in the 'outer' regions.
- A slice with the Z axis as normal showing that the speed linearly (color scaling is linear) increases as a function of the radius (distance to the closest point where $X=0$ and $Y=0$).

2 - Air quality of a kitchen

Question 1

What part(s) of the room are likely to collect dust? Indicate where these parts are and explain why the dust will collect there.



2 - Velocity magnitude slice at ground level with logarithmic scale

We assume that dust has a weight and is under the influence of gravity. Everyday observation in apartments reveals that dust rarely sticks to the ceiling. Dust can travel in the air for a certain time lapse but will eventually fall down on the ground. Thus, let us search for areas slightly above the ground where the air velocity is the lowest (nearly zero).

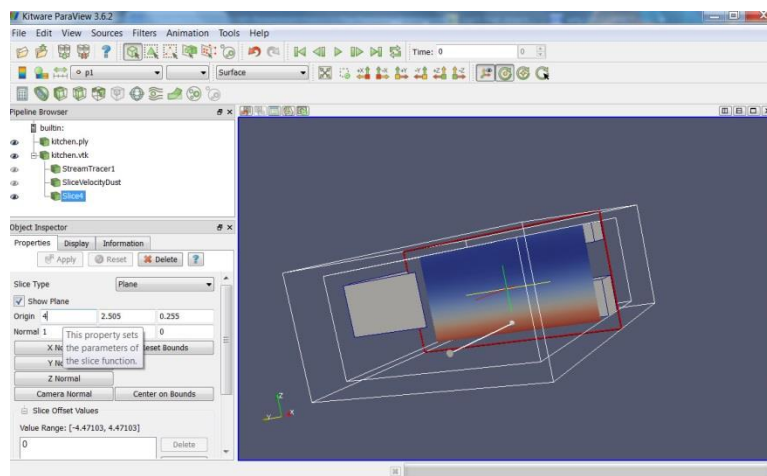
The logarithmic scale allows a better discrimination for lower values, which is what we need. The image above shows in green the areas where the dust is likely to collect: the dark blue area in the slice. The dark blue stains in the center of the kitchen are neglected: people may walk here and generate air flow that chases the dust.

Question 2

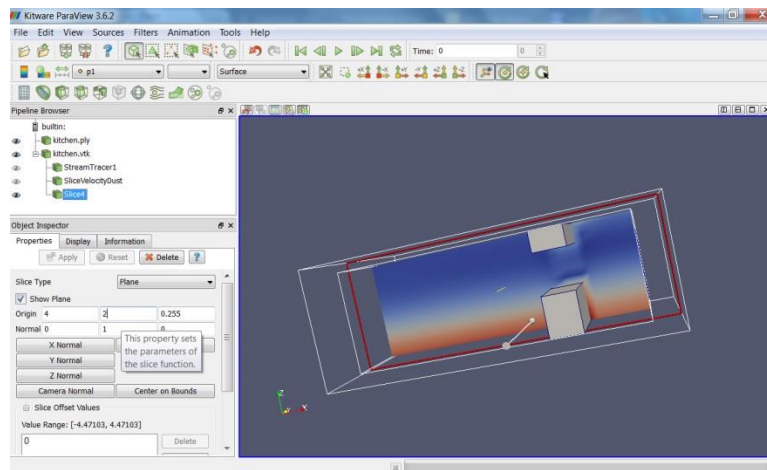
What part(s) of the room have the highest pressure, and what is that pressure? Indicate the position(s) of highest pressure, and provide a numerical value for the pressure.

Finding the highest pressure point involves to go through two steps: having a rough idea of where this point might be, and then finding it with precision.

The X, Y and Z slices help finding where the highest pressure point might be.

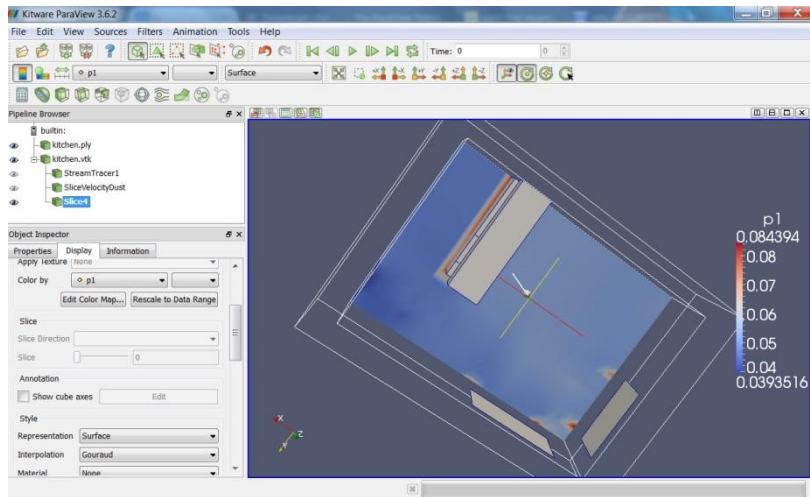


3 - X slice of scalar pressure field



4 - Y slice of scalar pressure field

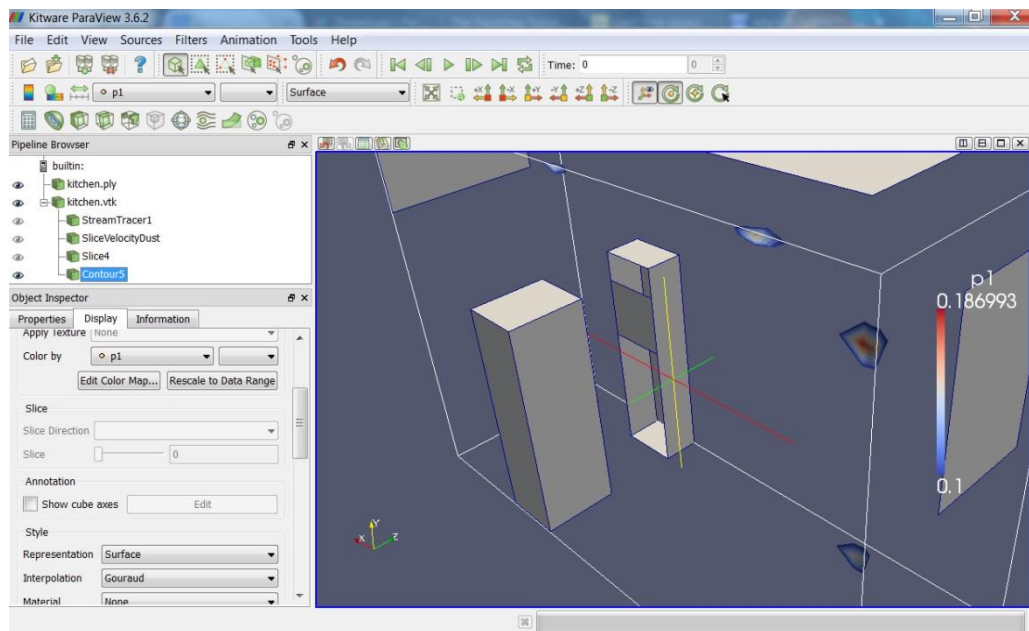
Both those views help understanding that the highest pressure levels are found with small Z values: on the ground.



5 - Z slice of scalar pressure field at ground level

The Z-slice at ground level unveils five potential areas for highest pressure point: along the workbench base and below the vertical borders of the windows.

The use of contours with wisely selected ranges allows a better look into the actual values in those areas:



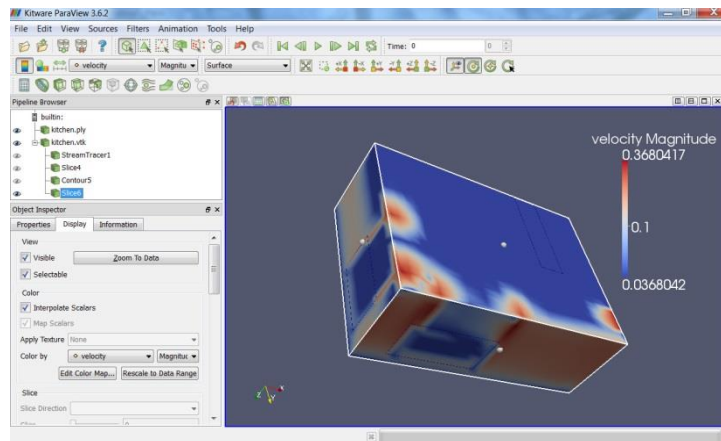
6 - Contour display of scalar pressure field for values between 0.1 and 0.186993

We have now found the highest pressure point with a value of $p_1 = 0.186993$ (we could have just checked the highest value in kitchen.vtk > Information). It stands right below the right border of the window in the front wall when entering the room.

Question 3

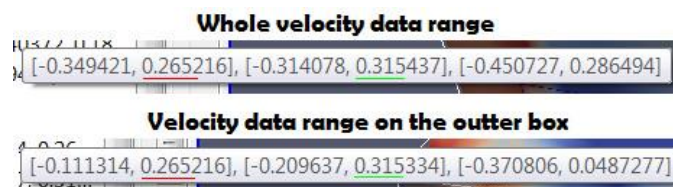
Where in the room is the largest air velocity magnitude and what is that magnitude? Indicate the position and numerical value.

To visualize velocity magnitude, we could use planar slices. But a good alternative in our case is the box slicing:



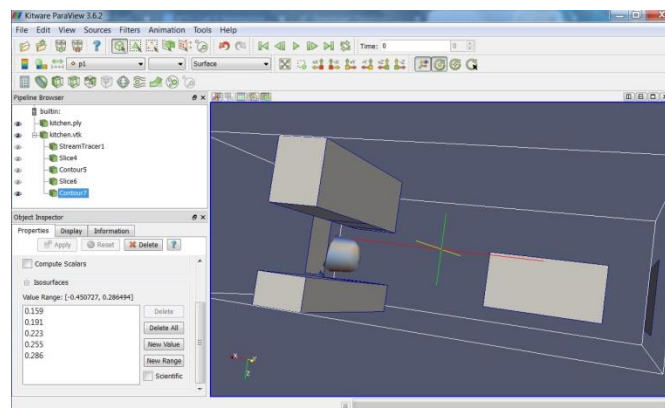
7 - Box slice of velocity amplitude field

While looking at the maximum velocity magnitude recorder on the outer box, we can see that global maximum is not reached. However, information provided by u_1 , v_1 and w_1 component vectors of velocity shows us that the highest velocity amplitude point is not far from the outer box planes:



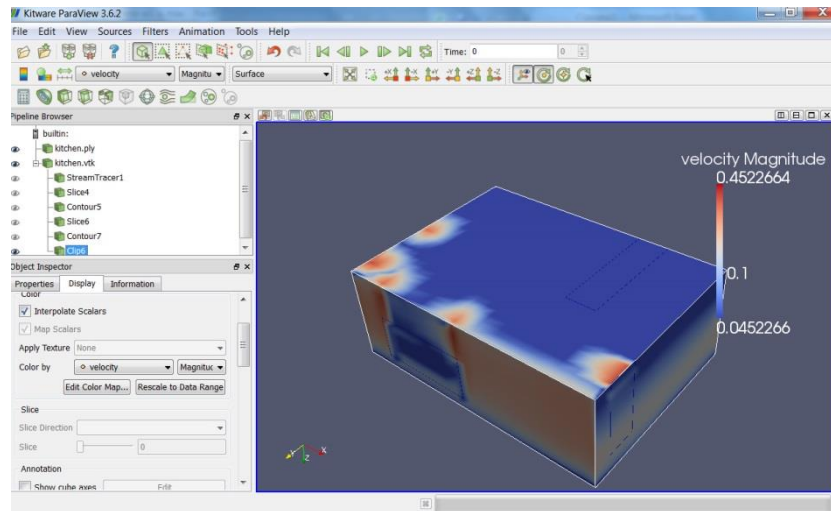
8 - Velocity component vectors data ranges

Especially because w_1 reaches its maximum value in this area, where u_1 and v_1 values are low:



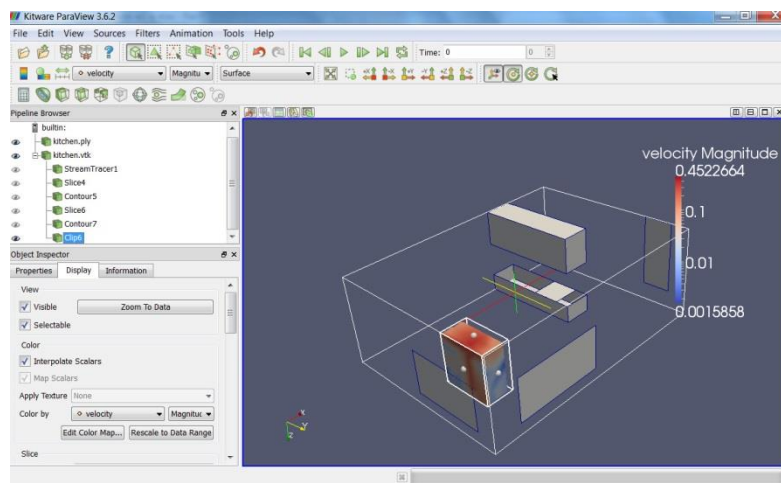
9 - Area where scalar field w_1 is maximal

Now, a tool we can use to scan the whole kitchen space is the Clip tool. Not only do we access the velocity amplitude values on the outer box, but also inside the box.



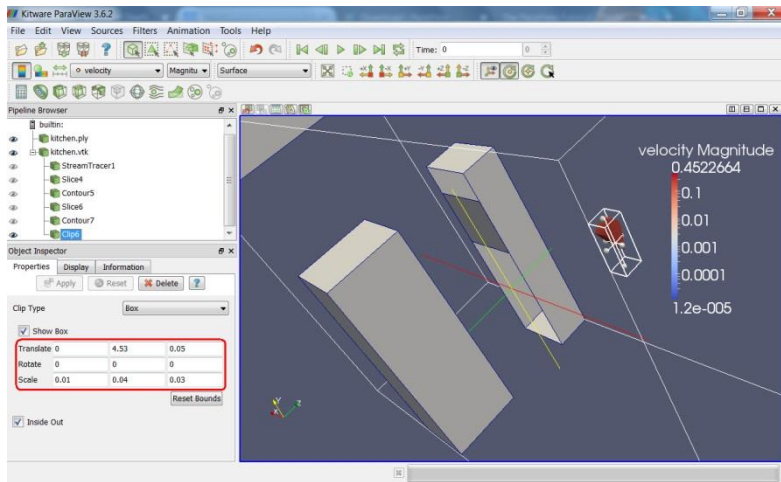
10 - Clip of velocity amplitude for the whole space

Logically, we hit the maximum somewhere in the volume. In order to find it, we can play with the scale and translate values of the box to see if we still contain the maximum value when we move it.



11 - Converging to the maximum of velocity amplitude

And then, we end up by locating the point:

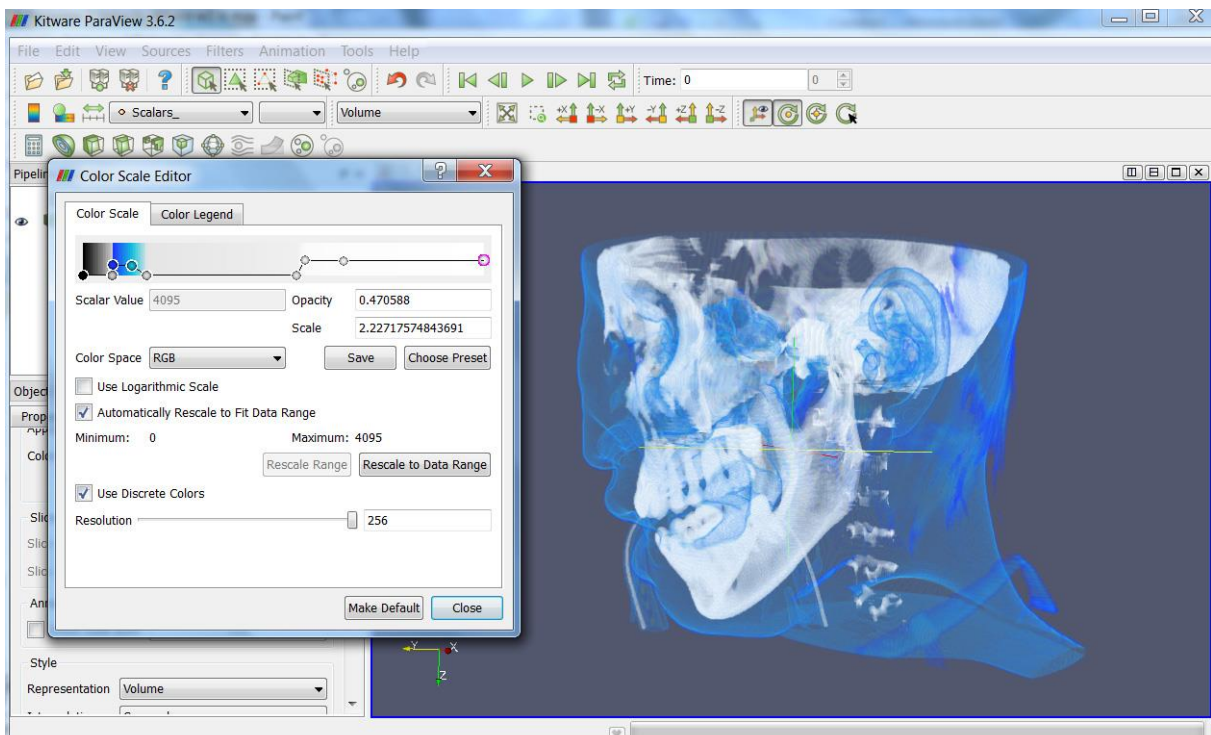


12 - Narrowed down to the highest velocity amplitude point

Its coordinates are approximately ($X=0, Y=4.55, Z=0.07$).

3 - Skin and skull

Here above are the final visualization and the corresponding transfer function.



13 - Skin and skull display with transfer function