

# HPC and Big Data

## Homework - Scientific Visualization

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### 1 Introduction

This is a report on the homework for the workshop Scientific Visualization in context of the University of Amsterdam (UvA) master course High Performance Computing and big Data (HPC). The homework assignment is to reconstruct the title page image of the courses handout, which can be found in the annex 3. Therefore we use the visualization program Paraview [1] with an optional back-end computation on the super-computer Surf [2].

### 2 Visualize the Mixer

We start by loading the dataset called `SMRX.vtk`. The data has a isosurface for the mixer and the simulated fluids represented by scalars, for the position and vectors, for the direction and velocity. The second step is to apply a contour filter and set it to visualize the surface.

The third step is to apply a stream tracer filter. The seed is set to a high resolution line source and laid in the origin of x- and z-axis and in the lower part of of the data's bounding box in direction of the y-axis. By choosing to display the vectors, we can visualize the velocity of the stream though the mixer. Further we apply a glyph filter to visualize the direction of the flow. Figure 1 shows the results.

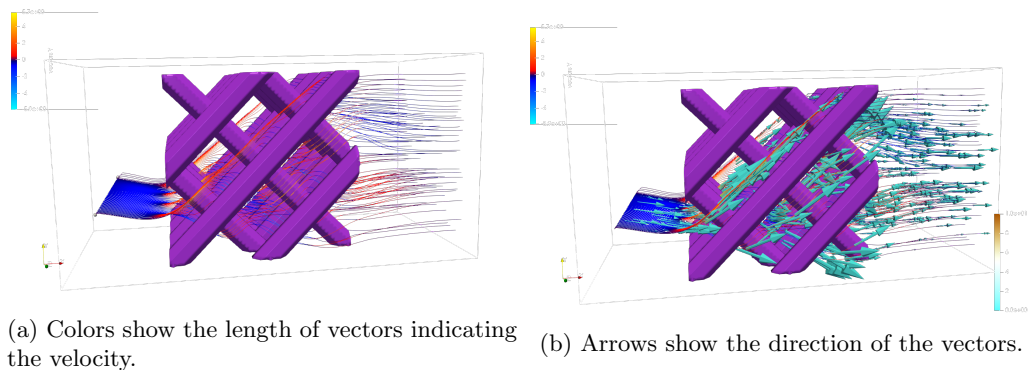


Figure 1: Visualization of the particle flow through the mixer.

To check if the mixer fulfills its purpose and mixes the incoming fluid, a second stream tracer is applied, locating the seed line similar to the first one but in the upper half of the bounding box in direction of the y-axis. In addition, a tube filter is added to make the stream lines more prominent. Figure 2 shows the results.

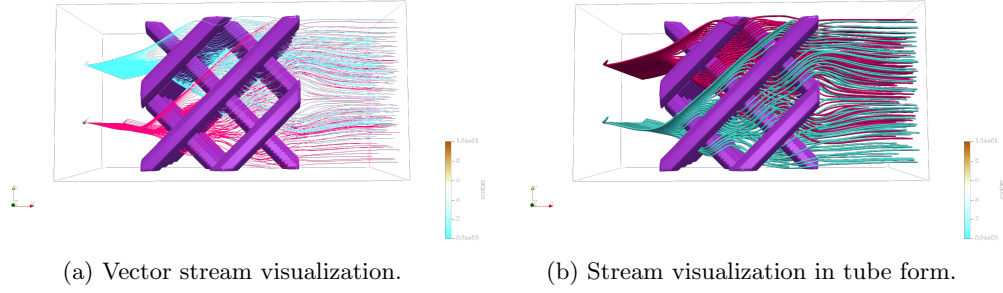


Figure 2: Mixing of streams from two different seeds.

### 3 Does the Mixer mix?

The answer to the assignment question is:

*Yes, the mixer in fact mixes the two fluids!*

Taking a closer look at figure 2 we see that the upper fluid does not completely reach the bottom while the lower in fact does reach the top. This might be due to different densities, temperatures or simply the shape of the mixer. Looking from above, we see the the stationary mixer also mixes in horizontal direction. Figure 3 shows that the horizontal fluid streams are split and mixed with the neighboring stream by the mixer. Concluding we can say, that this visualization aided at determining the functionality of this mixer. While the evaluation of the simulation data can also be done, computing the rate of mixing in different metrics, the visualization gives insight in the overall behaviour and reveals edge-cases.

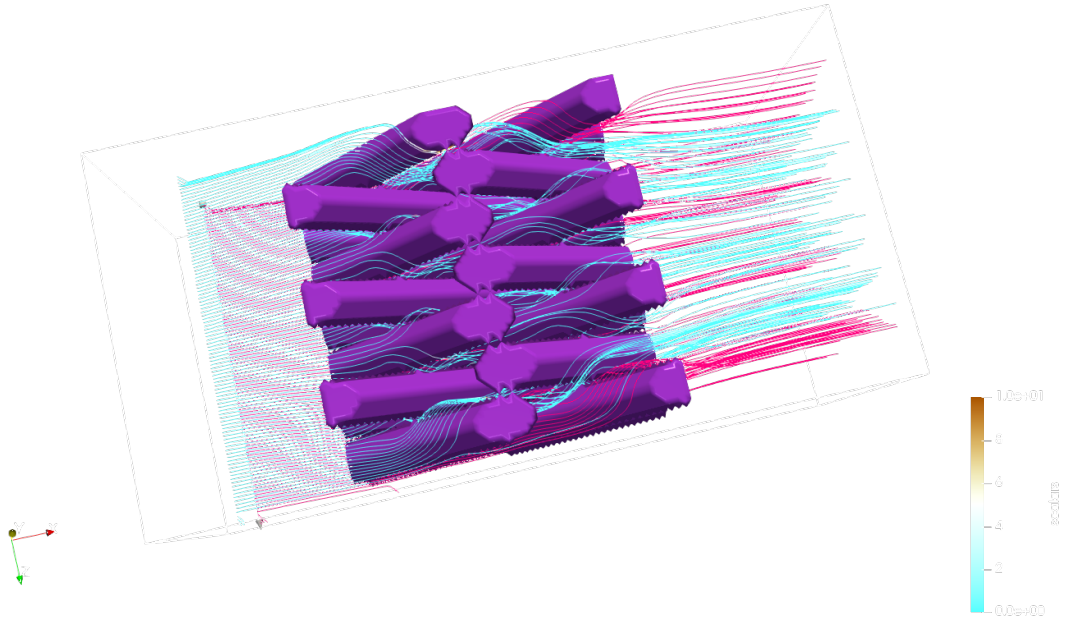


Figure 3: Mixing of the two fluids in horizontal direction.

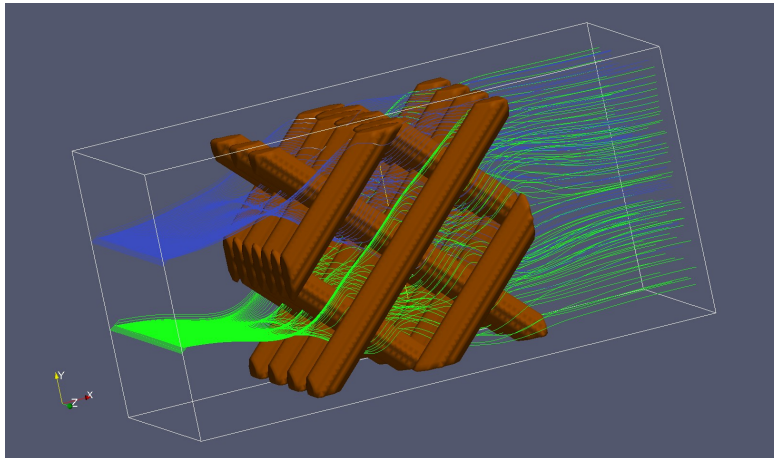
## References

- [1] James Ahrens, Berk Geveci, and Charles Law. Paraview: An end-user tool for large data visualization. *The visualization handbook*, 717(8), 2005.
- [2] Song Feng, ETH Torsten Hoefer, Switzerland Jessy Li, Damian Podareanu, Qifan Pu, Judy Qiu, Vikram Saletore, Mikhail E Smorkalov, and Jordi Torres. Valeriu codreanu, surfsara, netherlands ian foster, uchicago & anl, usa zhao zhang, tacc, usa.

## Appendices

# Scientific Visualization with ParaView

Updated 15-01-2018



Paul Melis, Casper van Leeuwen, Tijs de Kler



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