CFD Lab: Final Project

3D Navier Stokes Code for Arbitrary Geometries

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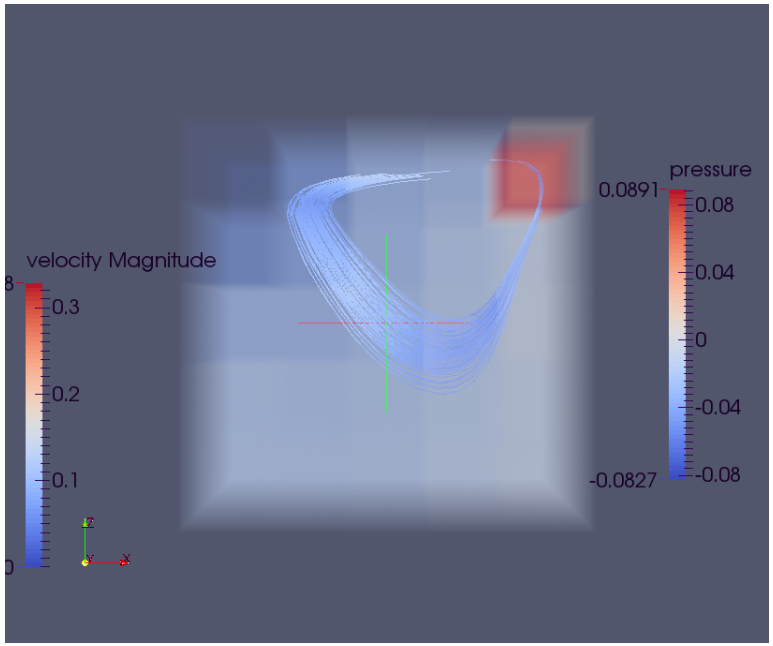
Project Topic

- 3D Navier Stokes for arbitrary geometries
- (TO remove Free Surface flow, unless we wanna explain why we didn't do it at the beginning of presentation??)



Project Topic

3D Navier Stokes for arbitrary geometries

- To handle truly arbitrary scenarios, our code allows any of the following standard boundary conditions to be employed in any domain cell:
  - no slip
  - free slip
  - inflow
  - outflow
  - moving wall
- Therefore, even the obstacles inside the domain can have arbitrary boundaries, as opposed to only allowing that on the domain walls (as in worksheet 3).

Implementation

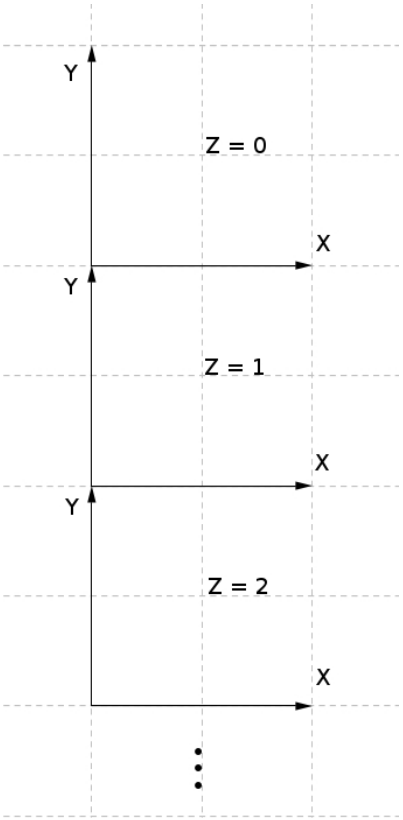
3D Navier Stokes for arbitrary geometries

- Special numbering of cells when generating input pgm files
- Geometries represented by a grayscale image with 7 levels of brightness.

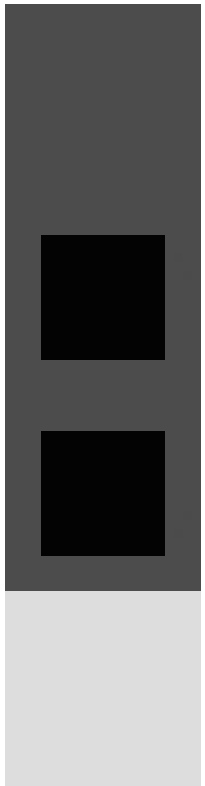
Cell type	Number code
water	0
air	1
no-slip	2
free-slip	3
inflow	4
outflow	5
moving wall	6

Lid driven cavity example case

...and its input pgm files



2	2	2	2
2	2	2	2
2	2	2	2
2	2	2	2
2	2	2	2
2	0	0	2
2	0	0	2
2	2	2	2
2	2	2	2
2	0	0	2
2	0	0	2
2	2	2	2
6	6	6	6
6	6	6	6
6	6	6	6
6	6	6	6



Implementation

Boundary conditions

- skip?

Implementation

Theory

	Palabos	**OpenLB**	**LBSim**	**SailFish**	**LB3D**
Language	C++ (Java, Python)	C++	C++	Python	Fortran90
Visualiz.	ASCII, gif	vtk	OpenGL	numpy, vtk	XDR

Implementation

Problems

blablablablabblalalablbablalalalabla

Title

Subtitle

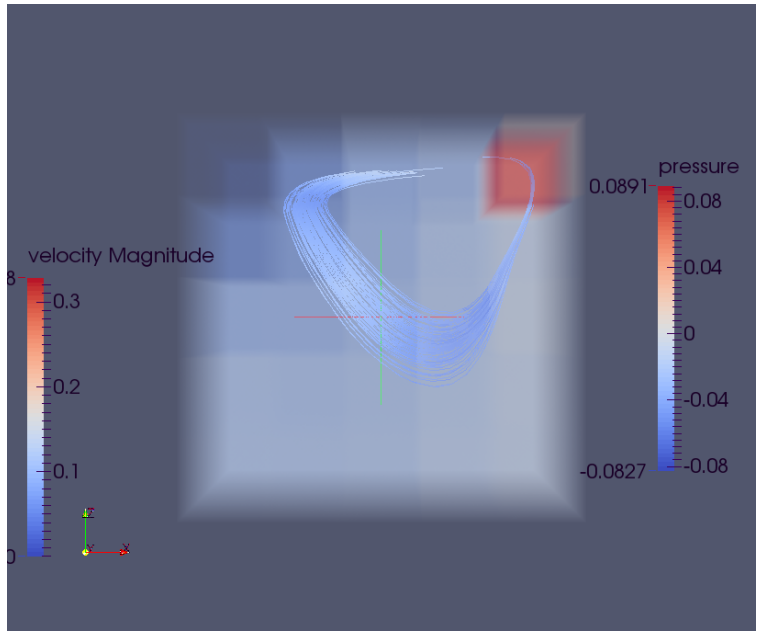
- first
- second
  - second sub 1
  - second sub 2
- own third

Important: Something.

Parameters used for the simulation: alalalalala

Results:

one	5.217 s
two	6.999 s
three	5.522 s



Some links

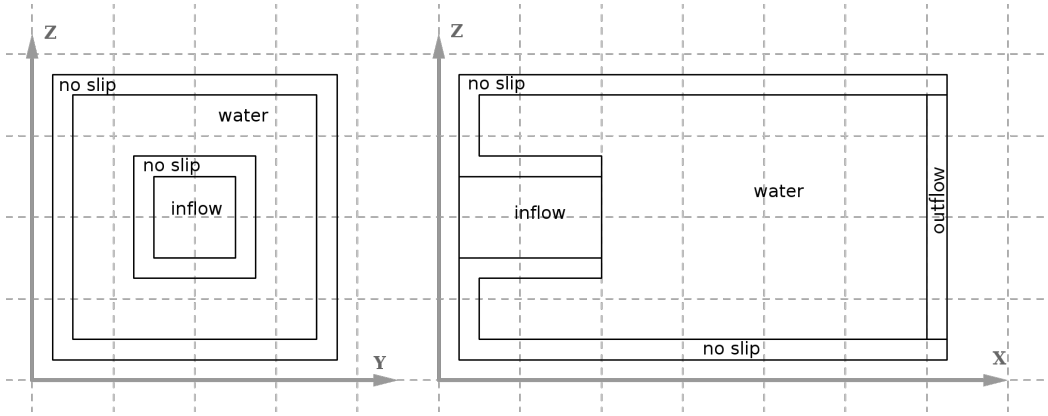
Palabos

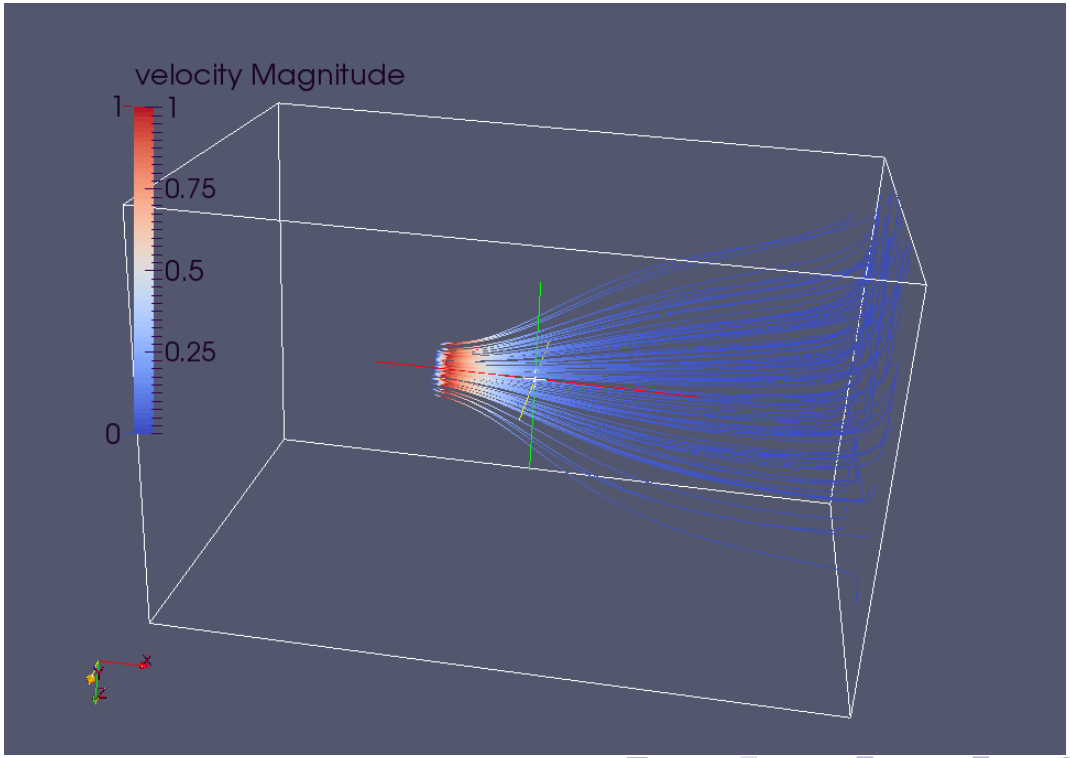
- Dam Break (free-surface flows):
  `http://www.palabos.org/gallery/multi-phase-free-surface-flow/23-dam-break`
- Volcanic Eruption
  `http://www.palabos.org/gallery/incompressible-isothermal-flow/22-volcanic-eruption`
- Rayleigh-Taylor Instability:
  `http://www.palabos.org/gallery/incompressible-isothermal-flow/43-rayleigh-taylor-instability`

Result

Inflow through a pipe

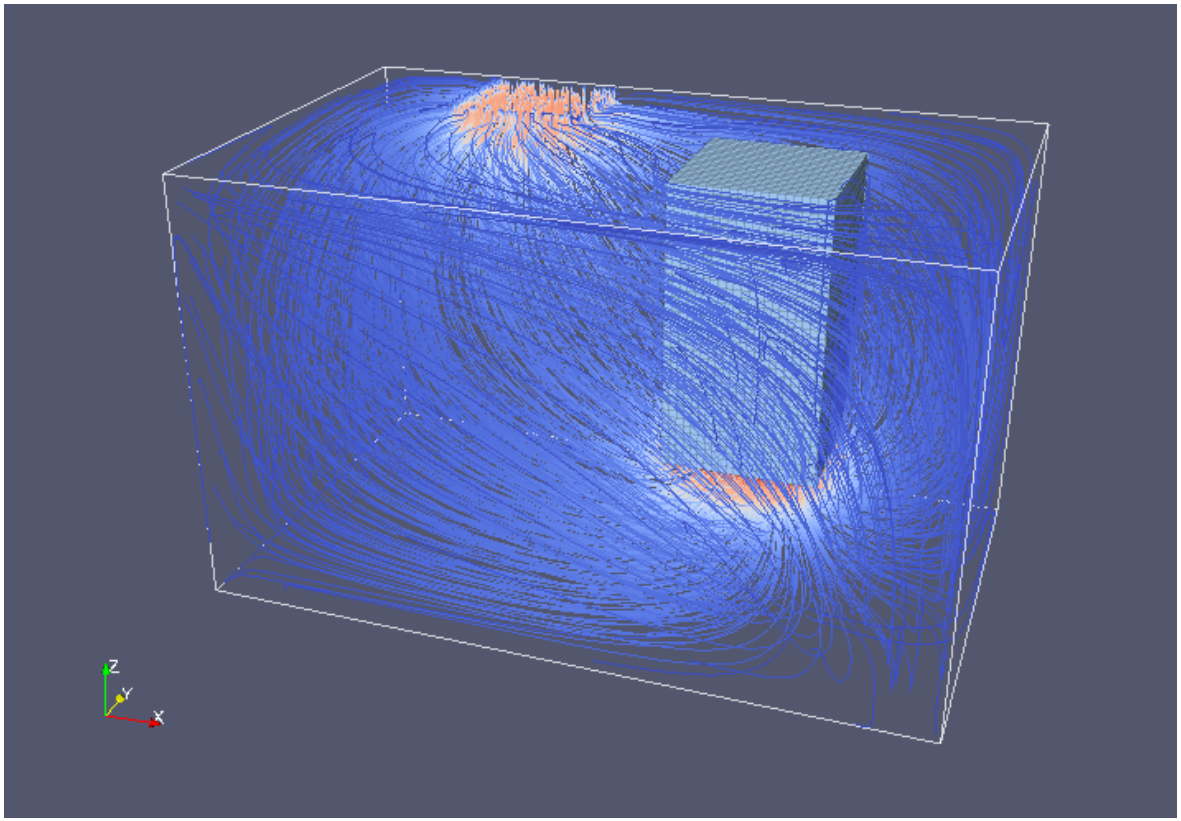
- Geometry
- Streamlines





Result

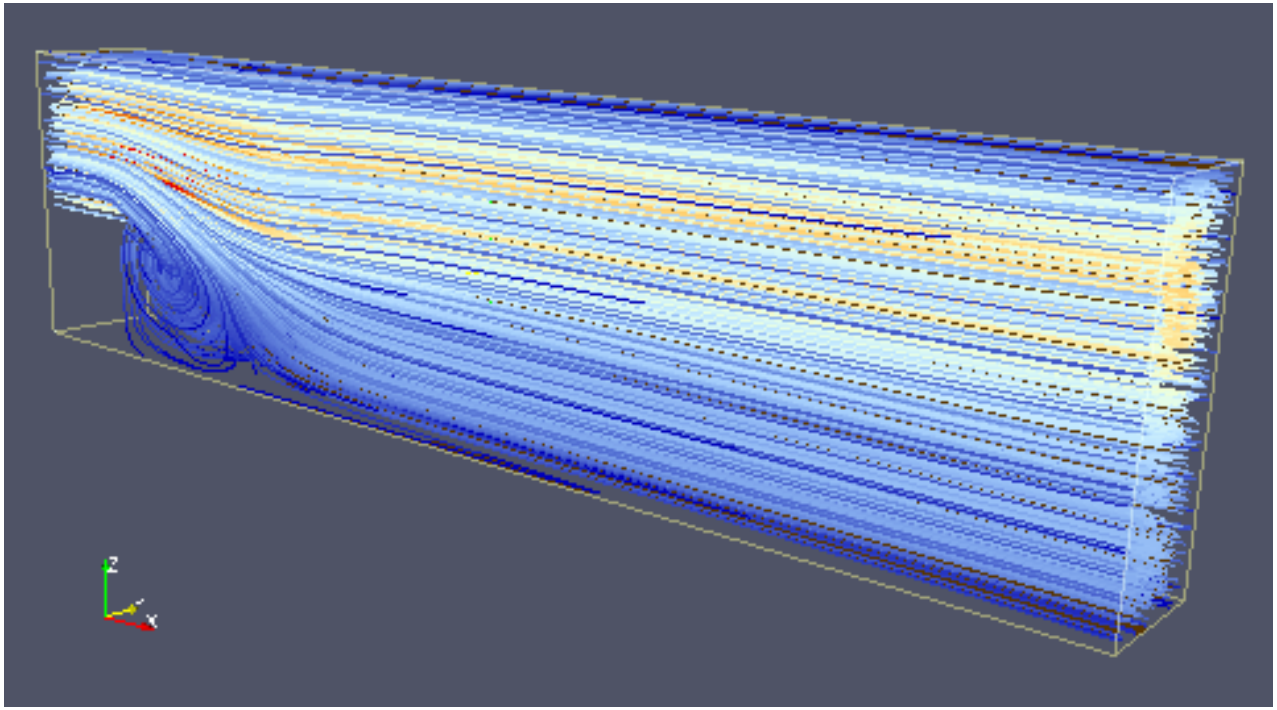
- Inflow through part of wall
- Outflow through pipe



Result

Flow over step

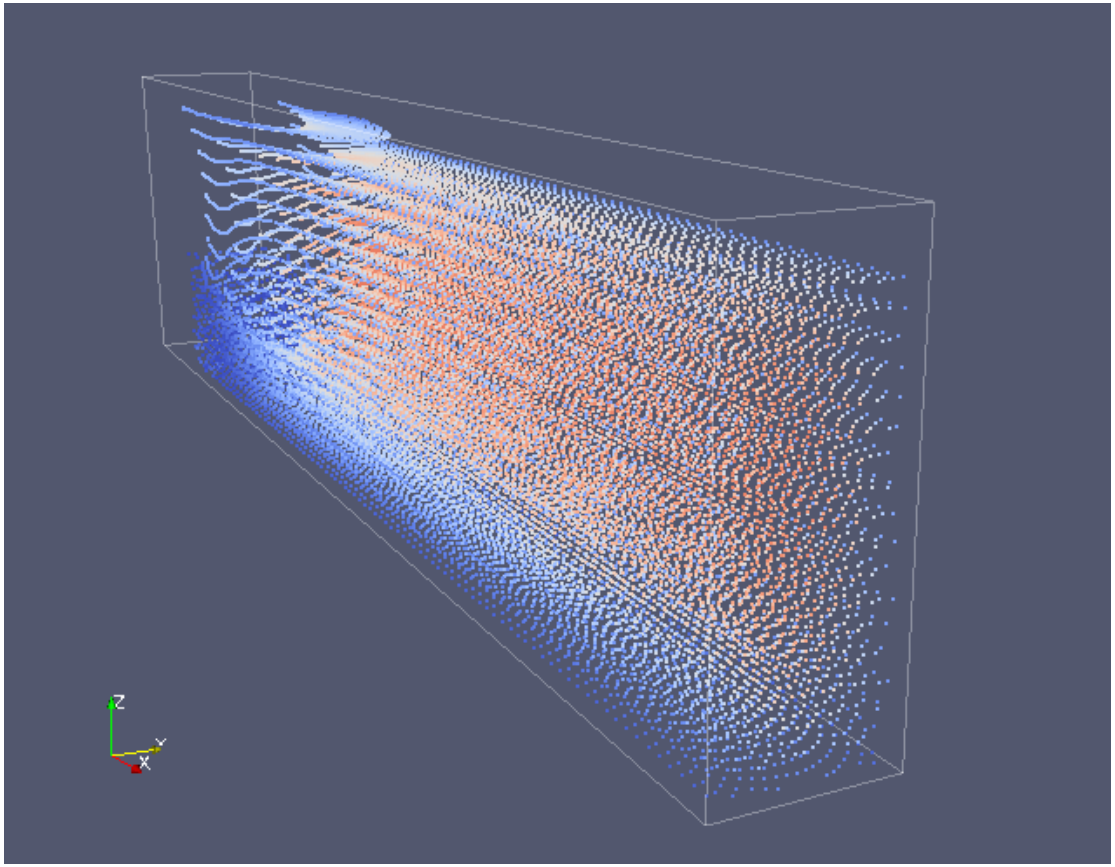
- Streamlines



Result

Flow over step

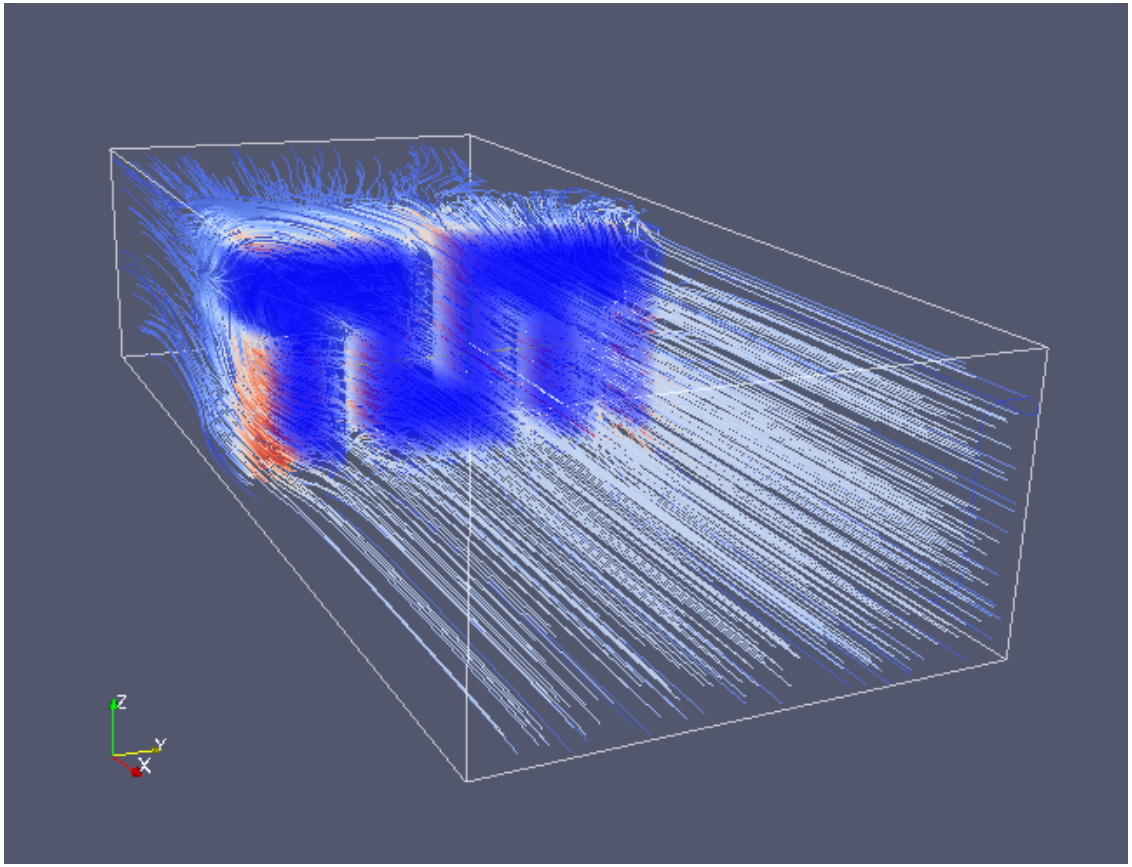
- Particle paths



Result

Flow across TUM :)

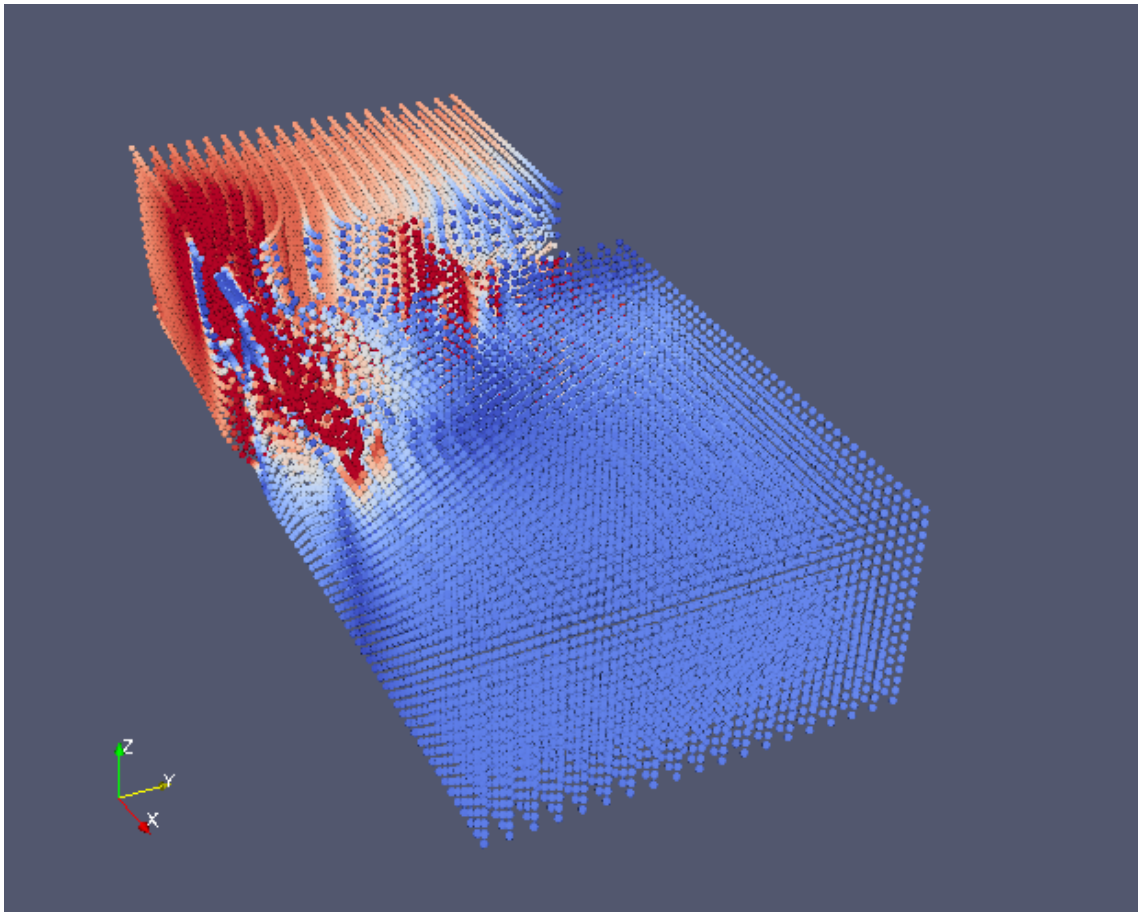
- Streamlines



Result

Flow across TUM :)

- Particle paths



Conclusion and Further Development

- Conclusion
- Further Development
  - Free Surface flow
  - Parallelization