

Research Activity at CEMPS University of Exeter

Status at 16 February 2012

Outline

Macro-scale simulation:

- Implementation of classes and solvers for the coupled fluid-solid simulation on multiple mesh regions

Micro-scale simulation:

- Generation of meshes starting from micro-CT scans
- Simulations of the scanned foams: preliminary results

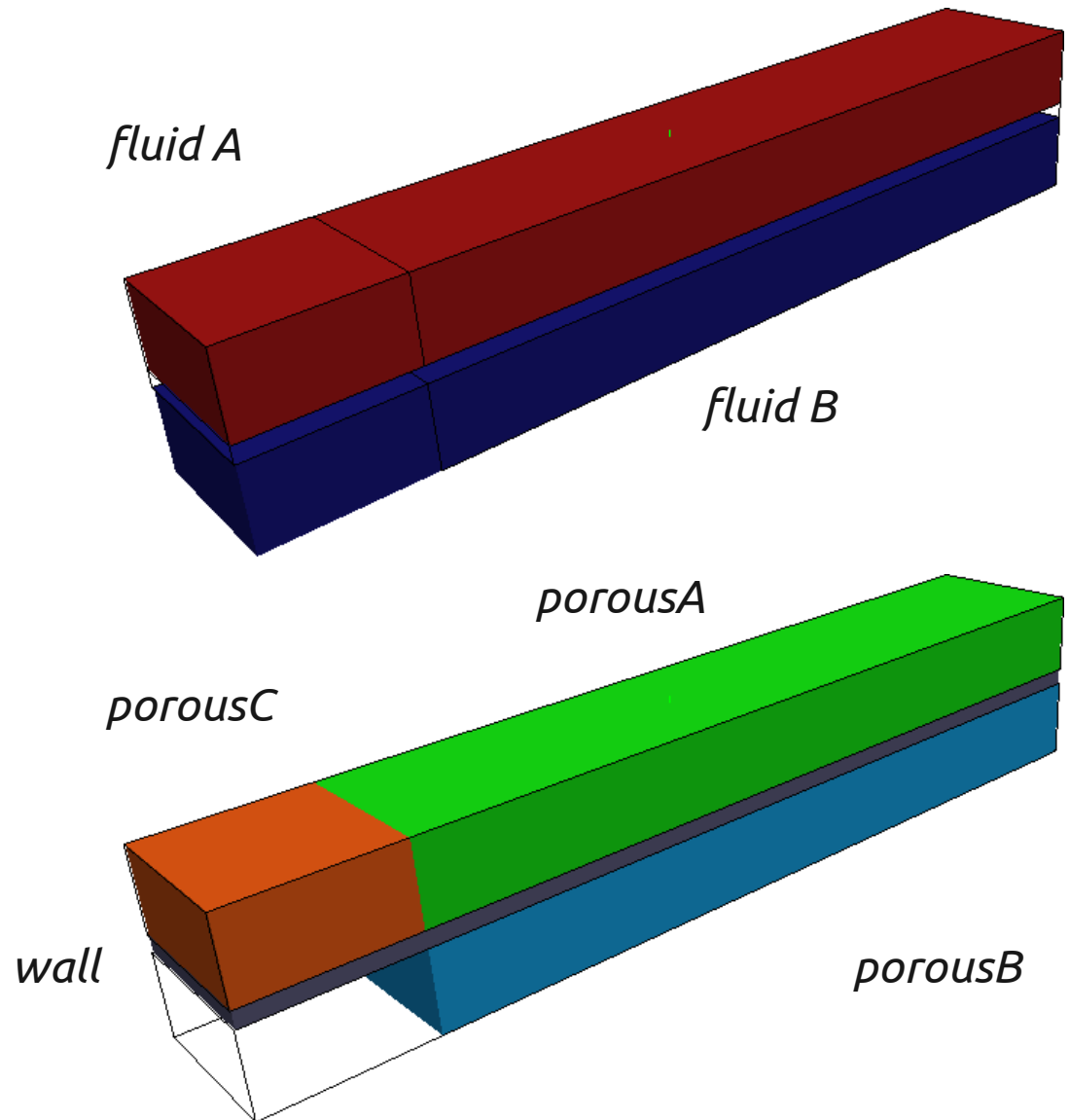
Macro-scale simulation

Implementation of classes for the definition of coupled fluid – solid zones on a multi region model.

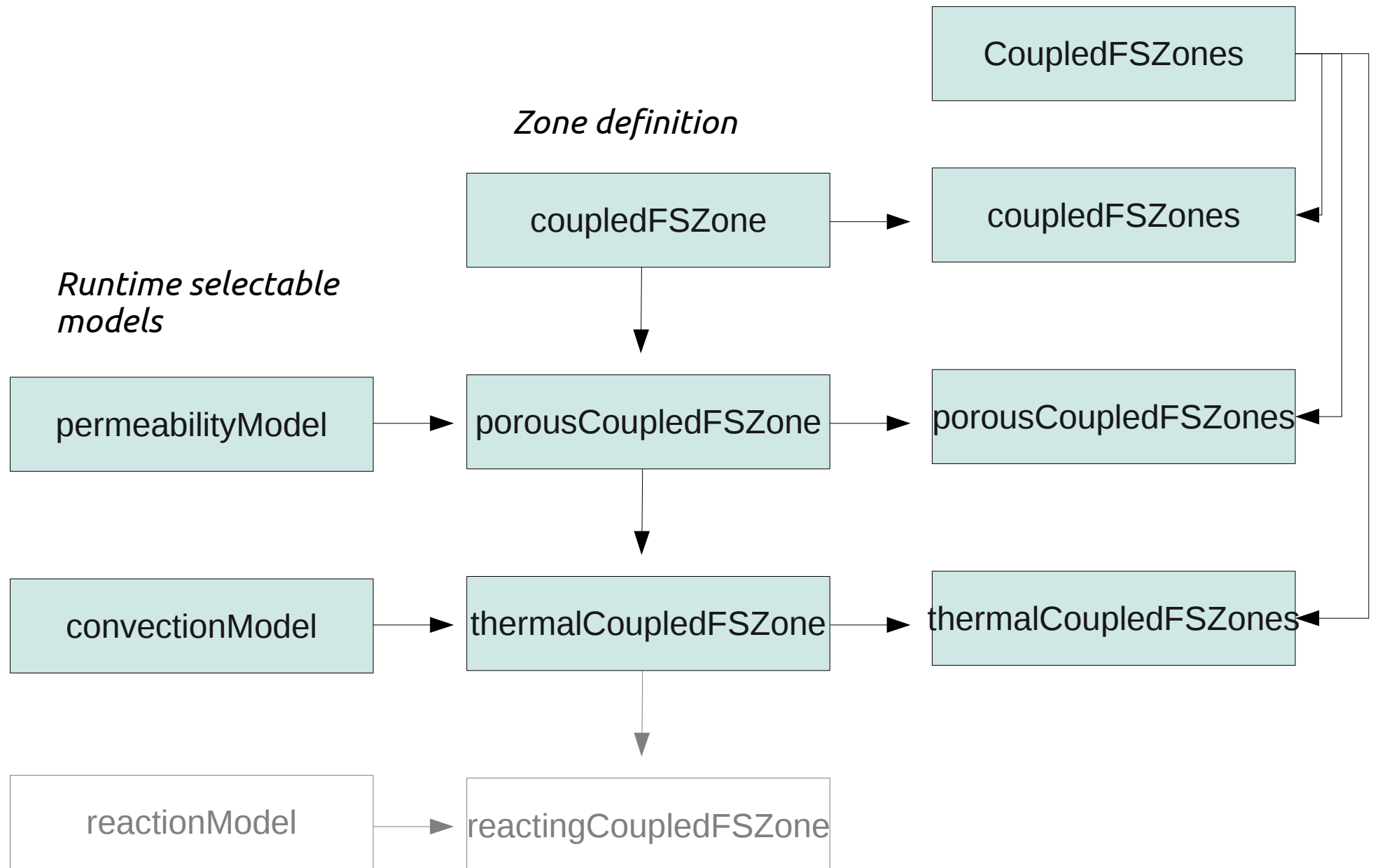
Example:

- 2 fluid regions: fluidA, fluidB
- 4 solid regions: wall, porousA, porousB, porousC
- 3 coupled fluid-solid regions: porousA, porousB, porousC

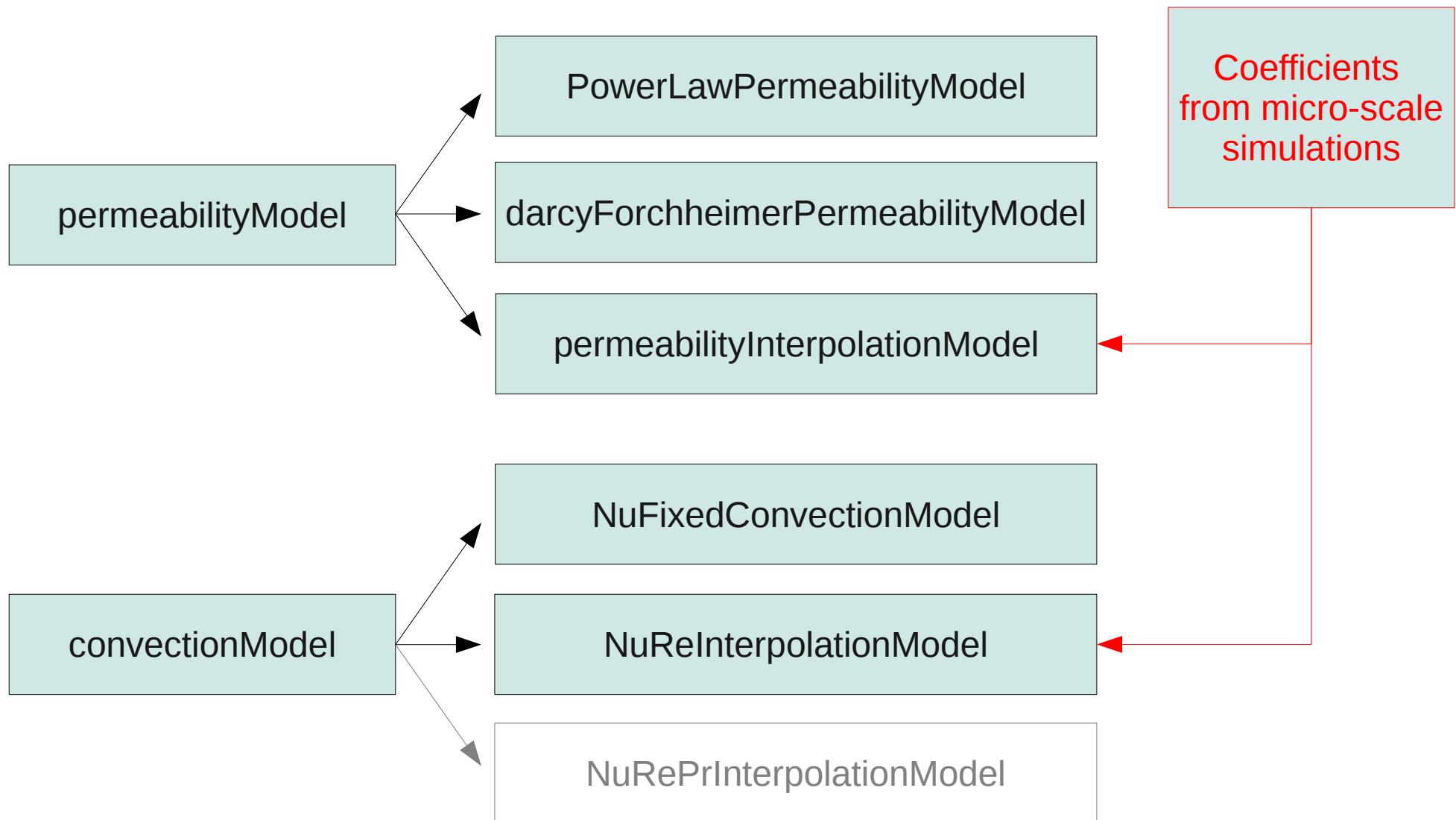
The extension of the solid zone coupled to a fluid zone may not coincide to the extension of the corresponding solid region.



Classes for the zone coupling on multiple mesh regions



Models for the coupledFSZone

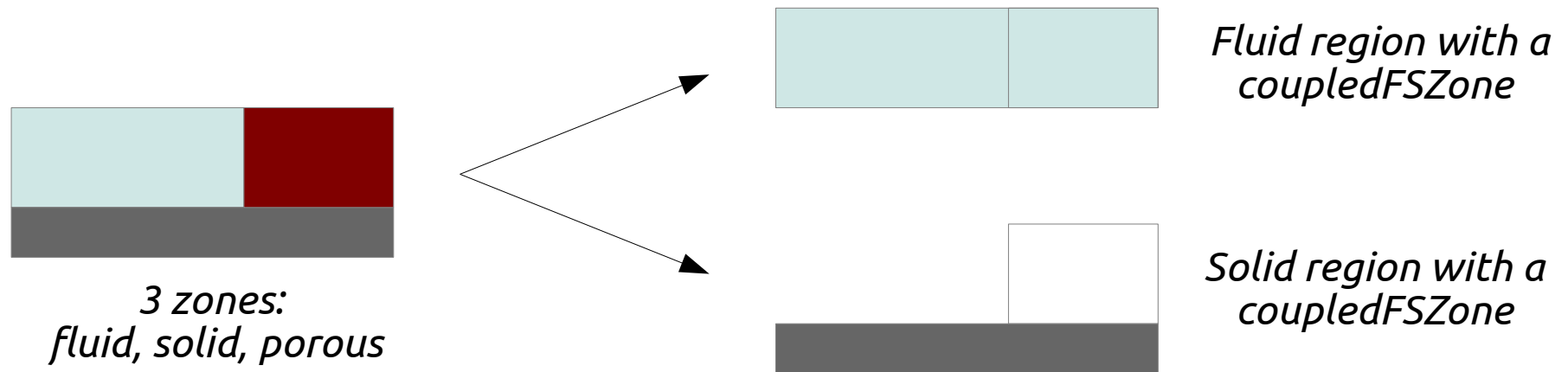


Classes for the multiple mesh regions simulation management

- `MultiRegionProperties` extends `regionProperties` with the definition of an incompressible fluid region for handling multiple compressible or incompressible fluid regions.
- `MultiRegionSimpleControl` and `MultiRegionSimpleControls` extends `simpleControl` for managing the solution converge check on multiple regions.

Multiple mesh region generation

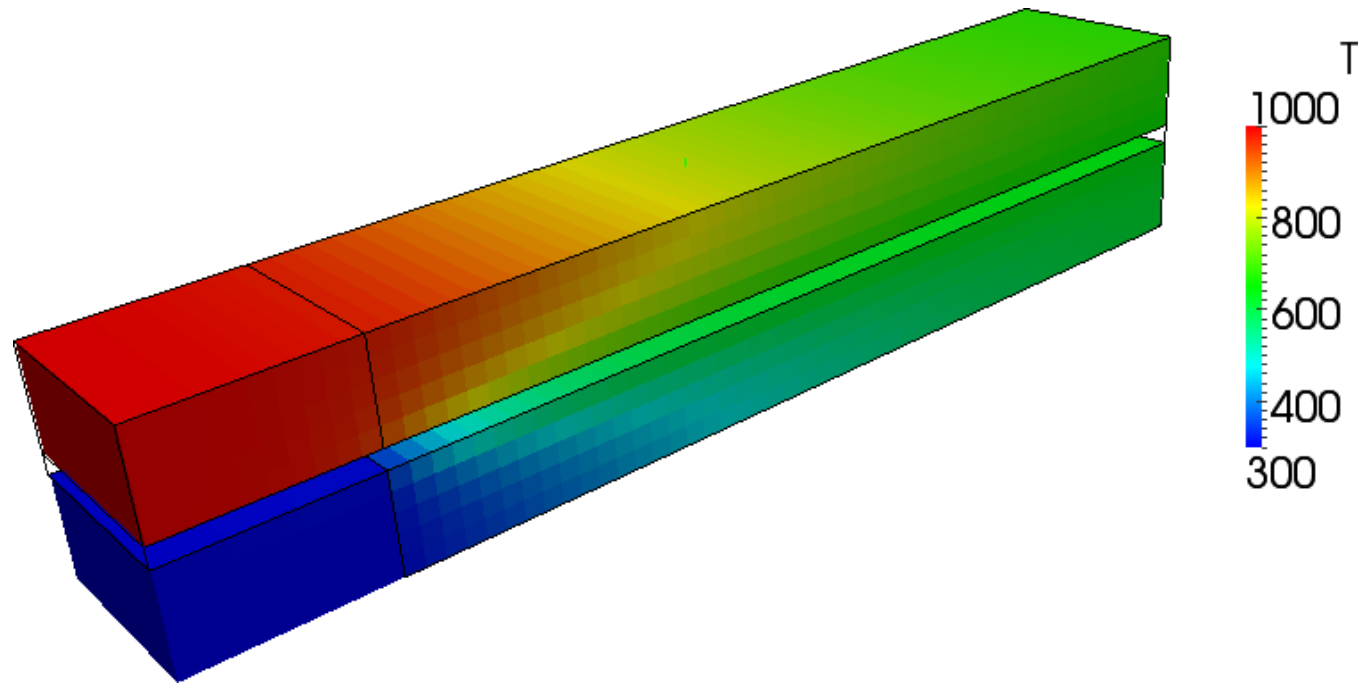
The generation of the coupled fluid-solid mesh can be done defining different fluid, solid and coupled cellZones on the base mesh. Using splitMeshRegion the different regions are created from the cellZones. The coupled regions are then added to the corresponding fluid region and solid regions using mergeMesh and stitchMesh. The coupled regions become in this way a cellZone on the fluid and solid meshes.



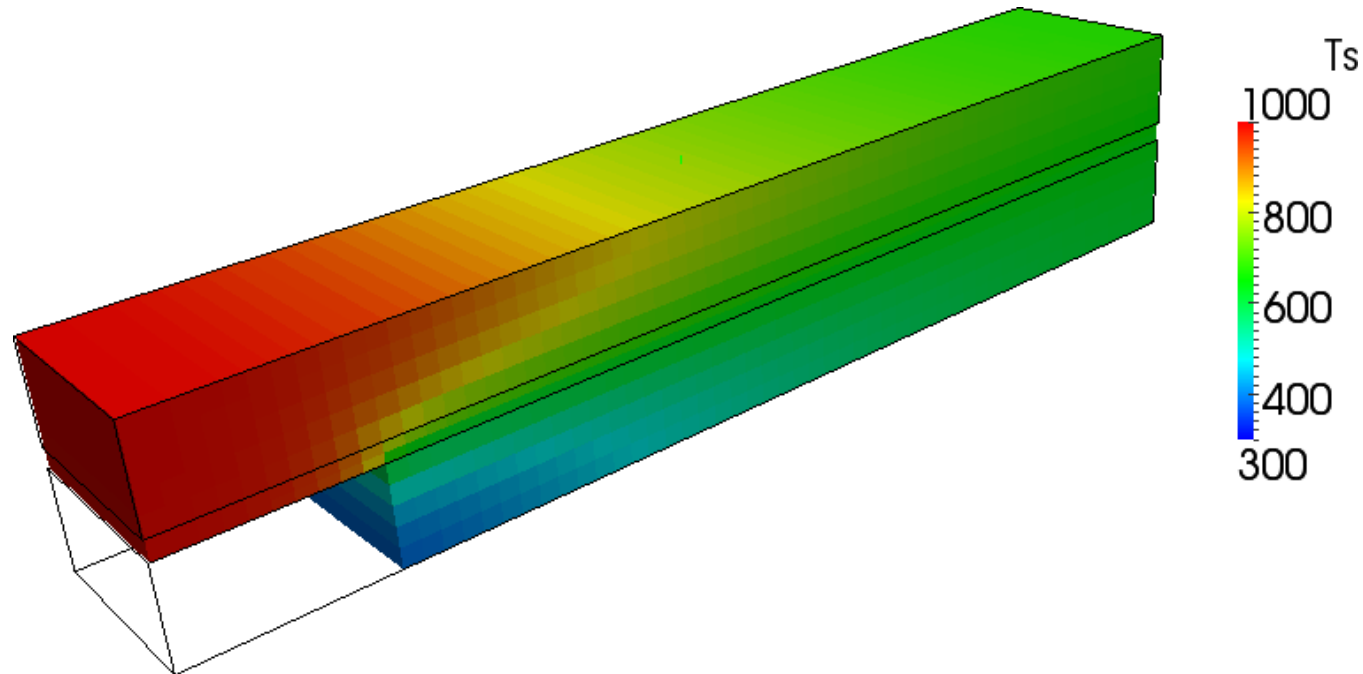
Alternatively two meshes (fluid+coupled and solid+coupled) can be created separately. In this case the addressing between the fluid and solid cells belonging the coupledFSZone is automatically defined by a function called by the cellFSZone constructor.

Test Case

*Temperature in the
fluid domains*

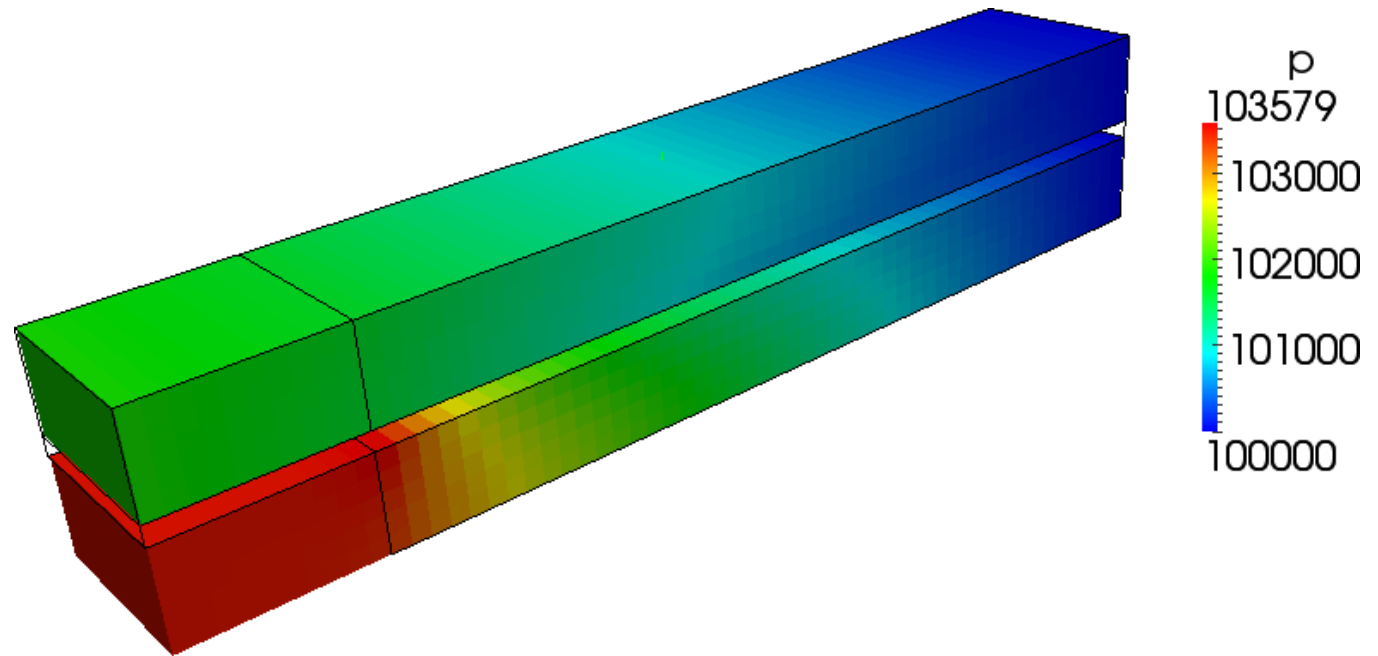


*Temperature in the
solid domains*

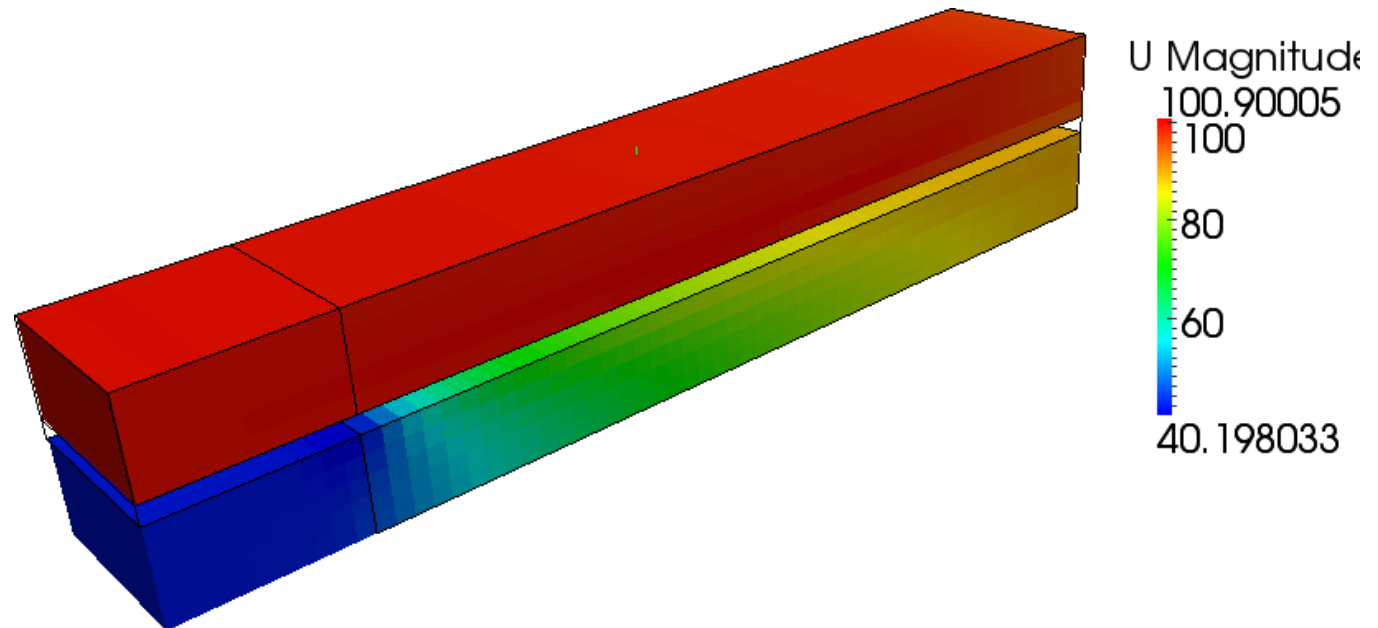


Test Case

Pressure



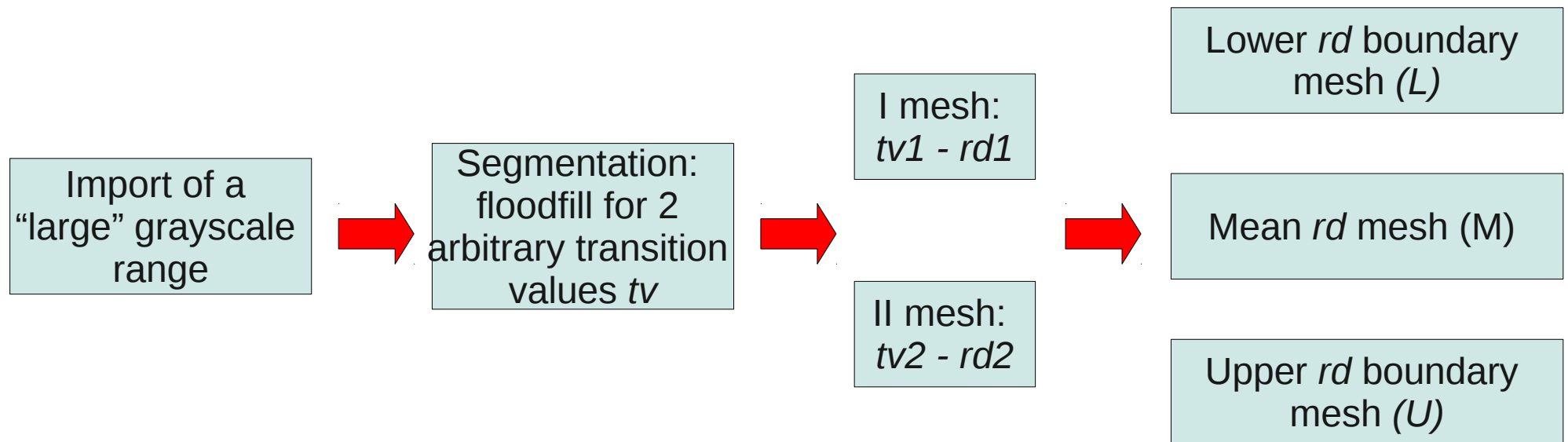
Velocity



Micro-scale simulations

Mesh generations starting from micro-CT scans:

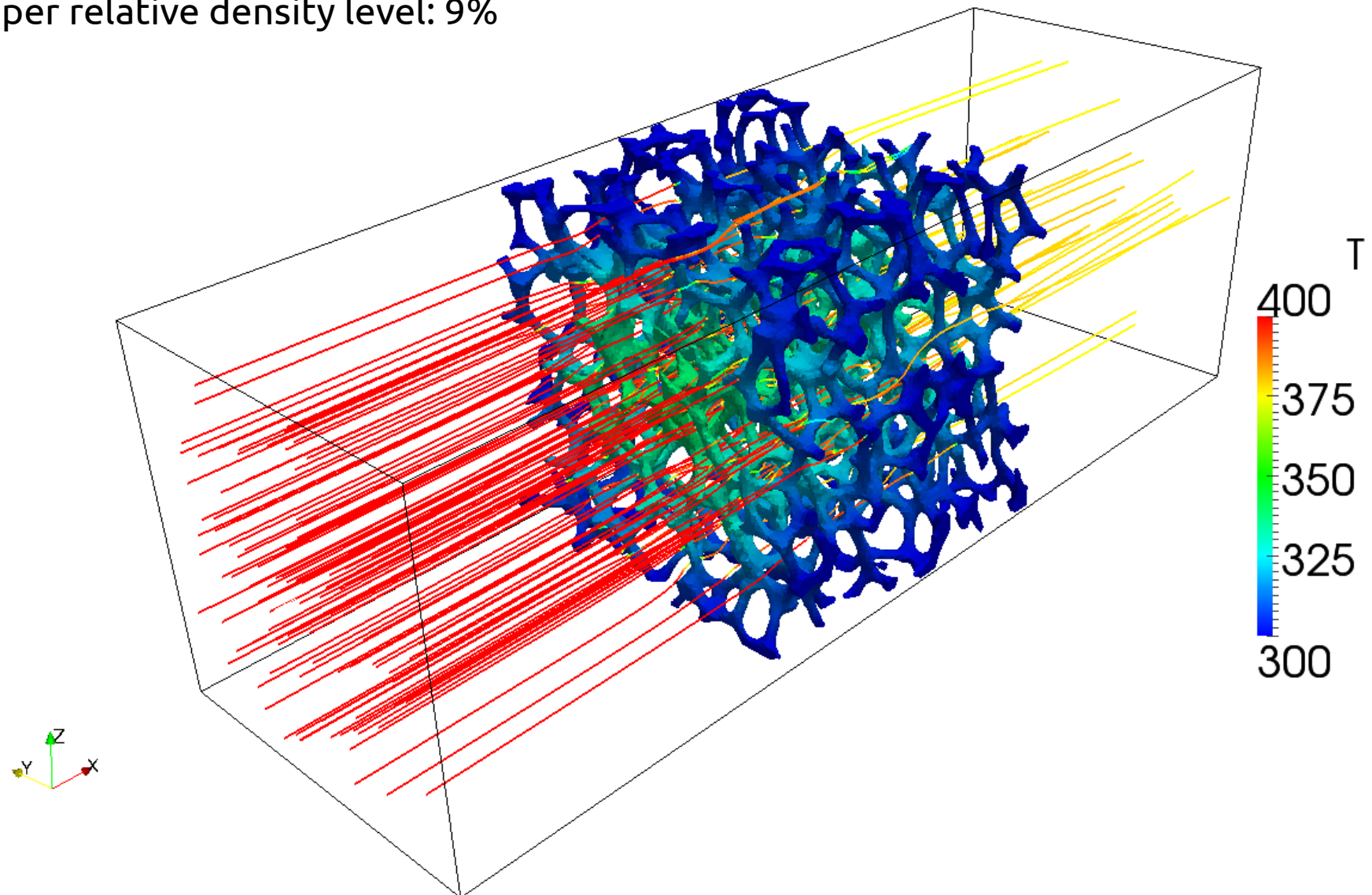
- Definition of a procedure for fitting the experimental relative density (rd) of the foam in *scanIP*. Since the relative measurement is affected by uncertainties a confidence interval is provided.



- Sensitivity analysis: investigation of how the properties change in the interval of relative densities considered.

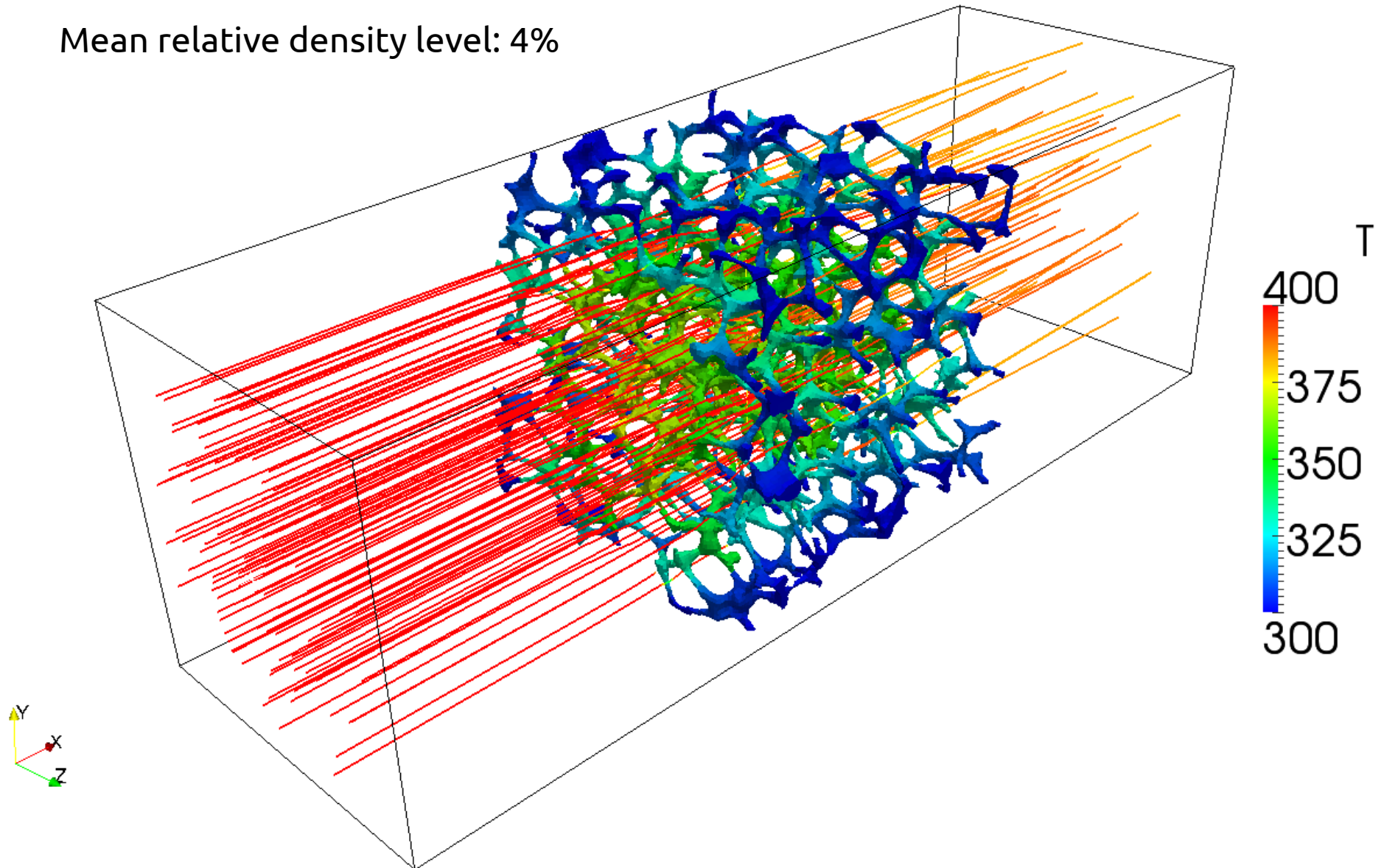
Preliminary results S3 foam

Upper relative density level: 9%



Preliminary results S3 foam

Mean relative density level: 4%



Preliminary results DPF filter

