

Other tools

Balogh
Miklós

List of tools

LBM

Palabos

Sampling

Other open-source tools

Lecture 10

Balogh Miklós

April 14, 2015



Table of Contents

Other tools

Balogh
Miklós

List of tools

LBM

Palabos

Sampling

① List of tools

② LBM

③ Palabos

④ Sampling



Solver, Mesher, Post-processor

Other tools

Balogh
Miklós

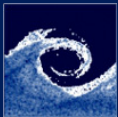
List of tools

LBM

Palabos

Sampling

- Solvers
 - Code-Saturne – general purpose solver
 - Open Flower – CFD solver in C++
 - Gerris – CFD solver in C++
 - Dolfyn – CFD solver for teaching
 - Palabos – lattice-Boltzmann solver
- Mesher
 - GMSH – 3D finite element mesher
 - Salome – 3D CAD software including mesher (GUI)
 - NETGEN – automatic 3D tetrahedral mesher
 - Discretizer – GUI for blockMesh and snappyHexMesh
- Post-processor
 - EnSight – CFD post-processor
 - Gnuplot – powerful tool for plotting
 - Octave – Matlab clone
 - Discretizer – GUI for OpenFOAM post-processing tools



lattice-Boltzmann method

Other tools

Balogh
Miklós

List of tools

LBM

Palabos

Sampling

- A class of computational fluid dynamics
 - The discrete Boltzmann equation is solved,
 - for a Newtonian fluid,
 - using collision models
- The concept differs from the Navier-Stokes solvers
 - CFD: conservation equations of macroscopic properties
 - LBM: fictive particles perform consecutive propagation and collision processes over a discrete lattice mesh
- Advantages over other conventional methods
 - dealing with complex geometry (e.g. aneurism, complex pore network)
 - incorporating microscopic interactions
 - parallelization of the algorithm (less memory)



lattice-Boltzmann method – Grids

Other tools

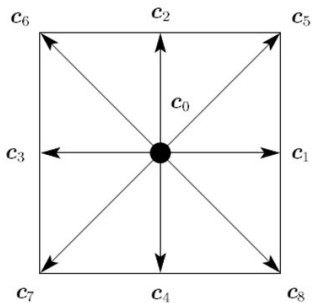
Balogh
Miklós

List of tools

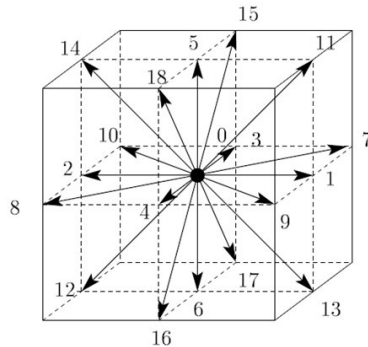
LBM

Palabos

Sampling



D2Q9



D3Q19



Palabos

Other tools

Balogh
Miklós

List of tools

LBM

Palabos

Sampling

- Palabos framework is a C++ library
 - Its kernel based on the lattice Boltzmann method
 - With no external dependencies (only Posix and MPI)
 - Additional programmer interfaces: Python and Java
- Physics
 - Incompressible Navier-Stokes equations
 - Weakly compressible, non-thermal Navier-Stokes equations
 - Flows with body-force term
 - Thermal flows with Boussinesq approximation
 - Single-component multi-phase fluids (Shan/Chen model)
 - Multi-component multi-phase fluids (Shan/Chen model, He/Lee model)
 - Free surface flows (volume-of-fluid approach)
 - Static Smagorinsky model for fluid turbulence



Other tools

Balogh
Miklós

List of tools

LBM

Palabos

Sampling

- Basic fluid models (collision)
 - BGK, regularized BGK
 - MRT
 - LW-ACM
 - entropic model
- Grids
 - D2Q9
 - D3Q13
 - D3Q15
 - D3Q19
 - D3Q27



Palabos – Example

Other tools

Balogh
Miklós

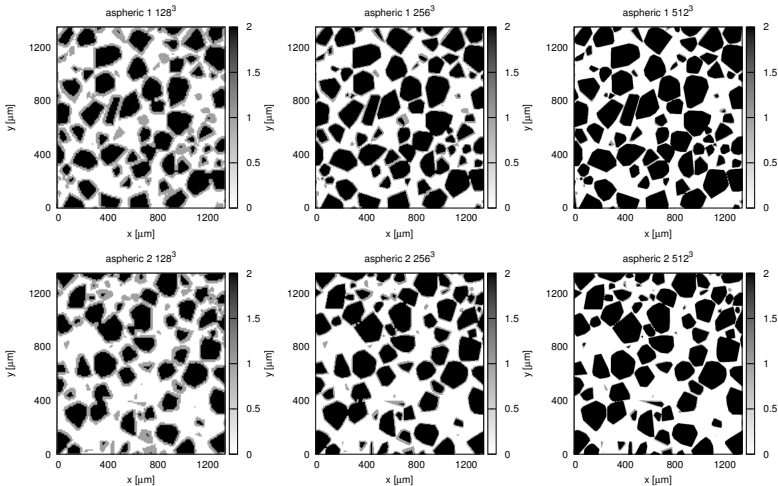
List of tools

LBM

Palabos

Sampling

Pore scale voxel map





Palabos – Example

Other tools

Balogh
Miklós

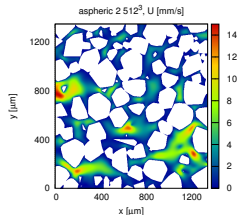
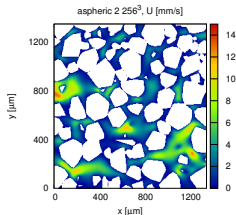
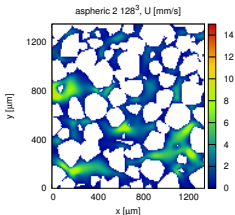
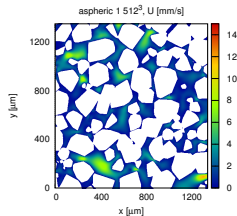
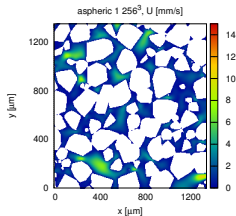
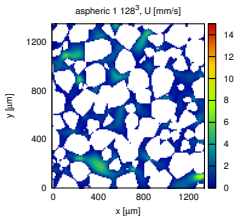
List of tools

LBM

Palabos

Sampling

Pore scale flow





Palabos – Example

Other tools

Balogh
Miklós

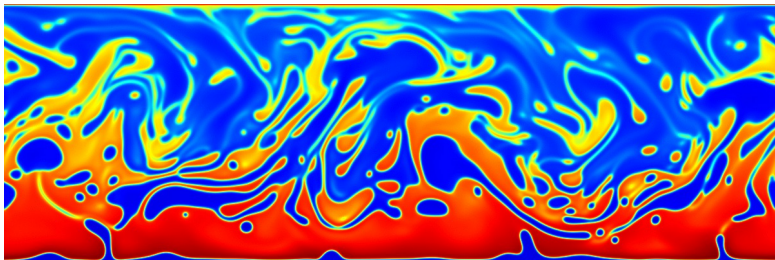
List of tools

LBM

Palabos

Sampling

Rayleigh Taylor instability





Sampling and plotting

Other tools

Balogh
Miklós

List of tools

LBM

Palabos

Sampling

- Sampling
 - Sample utility of OpenFOAM
 - Settings in sampleDict
 - Points, Profiles, Planes, Iso-surfaces
 - Formats: raw, gnuplot, grace, vtk, etc.
- Gnuplot – a demanding tool for plotting
 - Portable command-line driven graphic utility
 - Linux, OS/2, MS Windows, OSX, VMS and many other platforms
 - Originally created for scientists and students
 - To visualize mathematical functions and data interactively
 - It has grown to support many non-interactive uses
 - Plotting engine by third-party applications like Octave