**The Coupled model LBM-LSM**

1. **Objectives:**

* The purpose of this program is to determine the reaction of fluid-solid in the porous media with only one solid component. It provides the coefficient \alpha and \beta of the Christoffel equation.
* There is only a program for all simulations. The source code file is: filename.f

1. **The necessary files:**

* The source code file .f
* INPUT PARAMETERS:
* ind
* Cube\_abond
* Cube\_ang
* Cube\_bon
* Cube\_sbond
* Velocities9
* Velocities19

It is necessary to place these files in the same directory.

The files namely Cube\_\* and Velocities\* are the configurations of the lattice in the program; they must to be not changed.

The file “**ind**” is the numerical data of the porous medium of size Ncx . Ncy. Ncz. It must have exactly the same form as in the example. The solid is denoted by 0 and the pore by 1. In our calculations: quartz = 0, pore = 1.

The file **INPUT PARAMETERS** contains information about the simulation. The meaning of these coefficients are similarly to the program LBM-LSM2S.

1. **Compilation:**

Pgf95 –mp –fastsse –Mvect –mcmodel=medium file.f –o file.exe

1. **Run:**

ulimit –s unlimited

export OMP\_NUM\_THREADS= n (n: number of thread)

nohup ./file.exe &

1. **File outs:**

* **Alpha\_beta:** contains the results: \alpha and \beta
* Iteration, iteration2: The formation of lattice nodes, of bonds. They are used for rerun the program when it stopped unexpectedly. Do not stop program when two files 'iteration' and 'iteration2' at the same time exist. To continue the program after a break, one has change the parameter “read initial from iterations” in the file INPUT PARAMETER from 0 to 1.
* **Check\_state\_19**: gives the state of the simulation.
* **Settings\_19**: gives some information about the lattice.
* **Nohup.out** gives some information about possible problems.
* **Stress\_tensor, strain, stress**: some output files of the LSM step.
* **LSM\_icors, LSM\_coord\_field, LSM\_displ\_field, LSM\_force\_field, LSM\_velocity\_field**: they contain the information of each lattice point. They are used for verification if there is a problem with the results.
* **LSM\_disf\*, pressure\*:** information of displacement and pressure at each main iteration. They are used for verification if there is a problem with the results.
* **Color\_filed, ind\_red\_blue**: the files used for the two phase fluids simulations.

1. **Notices:**

* If the Young moduli in the INPUT are given by GPa, the result in the is also in GPa.
* The program is parallelized by OMP but not for the calculations at the interfaces; therefore, the parallelization is not very effective.