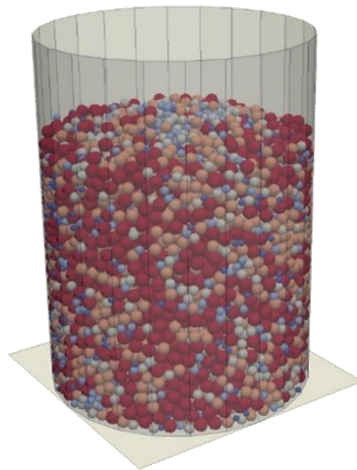




cemfDEM[®] tutorial

Two: Packing of Polydisperse Particles

Time: 1.70 s



A DEM simulation to create a random packed bed of spheres with size distribution

**Compatible
with**

gfortran-4.9, intel Fortran 2013, intel Fortran 2015, gfortran-7.5

Author

Hamidreza Norouzi



Amirkabir University of Technology



Center of Engineering and Multiscale Modeling of Fluid Flow

License Agreement



This material is licensed under (CC BY-SA 4.0), unless otherwise stated.
<https://creativecommons.org/licenses/by-sa/4.0/>

This is a human-readable summary of (and not a substitute for) the license. Disclaimer.

You are free to:

- **Share** — copy and redistribute the material in any medium or format
 - **Adapt** — remix, transform, and build upon the material
- The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:

- **Attribution** — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
- **Share alike** — If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original.
- **No additional restrictions** — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

Notices:

- You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation.
- No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material.

Extra consideration:

- This document is developed to teach how to use cemfDEM® software. The document has gone under several reviews to reduce any possible errors, though it may still have some. We will be glad to receive your comments on the content and error reports through this address: h.norouzi@aut.ac.ir

Table of Contents

1. Problem definition	4
2. Simulation setup	4
3. Running the program (on Ubuntu)	4

1. Problem definition

In this simulation, we create a random packed bed of spherical particles in a cylindrical container with the diameter of 15 cm and height of 20 cm. Particles are a mixture of spherical particles with similar density (2500 kg/m^3) and uniform sizes distribution between 3 and 7.5 mm. In the following, we describe how to set-up a simulation case using the cemfDEM® code.

2. Simulation setup

Download the simulation setup files from the [github repository](#) of the code or copy them from “./tutorials/ packingPolydisperse” folder into the main root of the source code. Some code lines of the source file main.f90 are shown in Listing 1. Setting-up the code consists of some steps that are described below.

This simulation is very similar to “Tutorial One: Packing of Mono-sized Particles” and so does most of the code lines for setting up the simulation set-up. Therefore, **the reader should also read the tutorial one before reading this tutorial**. Here, the part which is different is explained.

Particle with uniform size distribution should be created/defined in the simulation. Line 45 in Listing 1 (a part of main.f90) creates 15000 particles with sizes between 3 and 7.5 mm which are classified into 5 bins. Note that not all the source code lines are shown here.

Listing 1: statements to produce a mixture of particles in file main.f90

```
41 // . . . some code lines . . .
42
43 !particles with uniform size distribution
44 !Size range of particles is between 3 and 7.5 mm which are classified into 5 bins
45 PSD = PS_Distribution( 15000 , PSD_Uniform, 5 , 0.003_RK, 0.0075_RK )
46
47 // . . . some code lines . . .
48
```

3. Running the program (on Ubuntu)

Before building and running the simulation, make sure that all the required files (main.f90, ProgramDefinedGeometry.f90, User_Mark.f90 and makefile) and folders (“Results”) are located

in the main folder of the program. For building and running the program, change the current directory to the main folder of the code (if it is not already) in the terminal and enter the following command:

```
> make
```

This builds the executable file (if no error occurs) of the simulation. Enter the following command to execute the program. Depending on the computational resources available on your PC, the execution may take between several minutes to some hours.

```
> ./cemfDEM
```

Results of this simulation are visualized using ParaView®. Three snapshots of the container during filling process are shown in Figure 1.

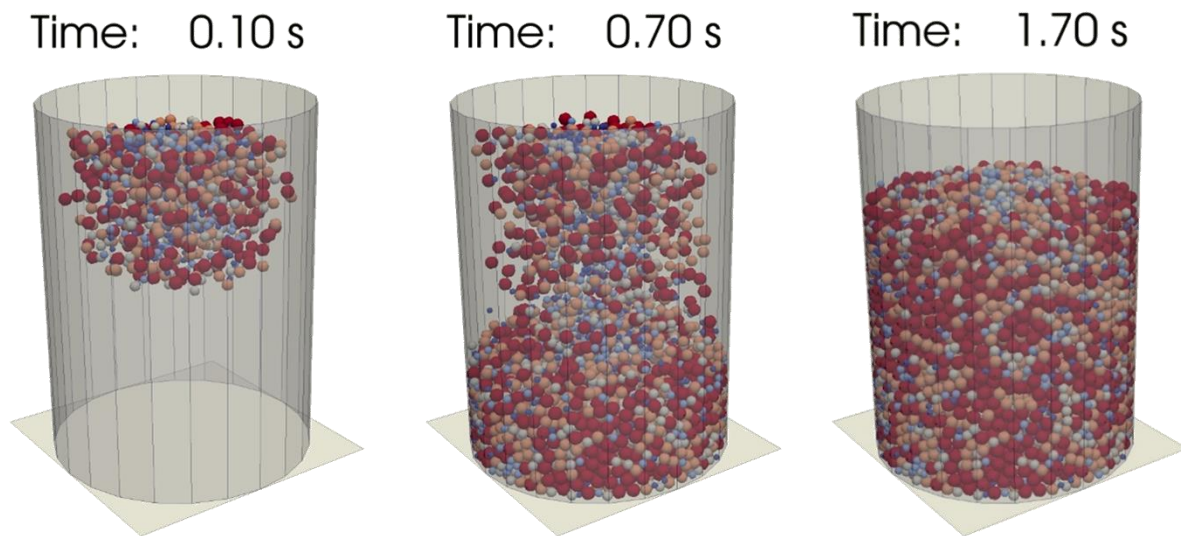


Figure 1: Packing of spherical size distribution