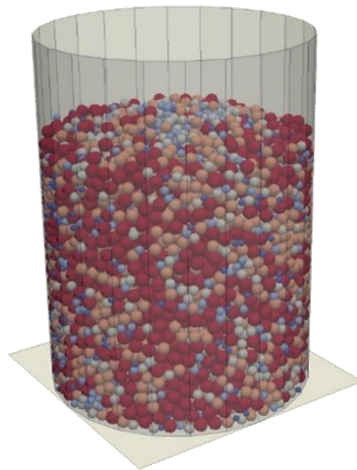# cemfDEM® tutorial

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

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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

Document history

Revision	Description	Date
Rev1	The final version is prepared.	Dec - 12 - 2020
Rev0	The first version is drafted.	Dec - 08 - 2020

Table of Contents

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

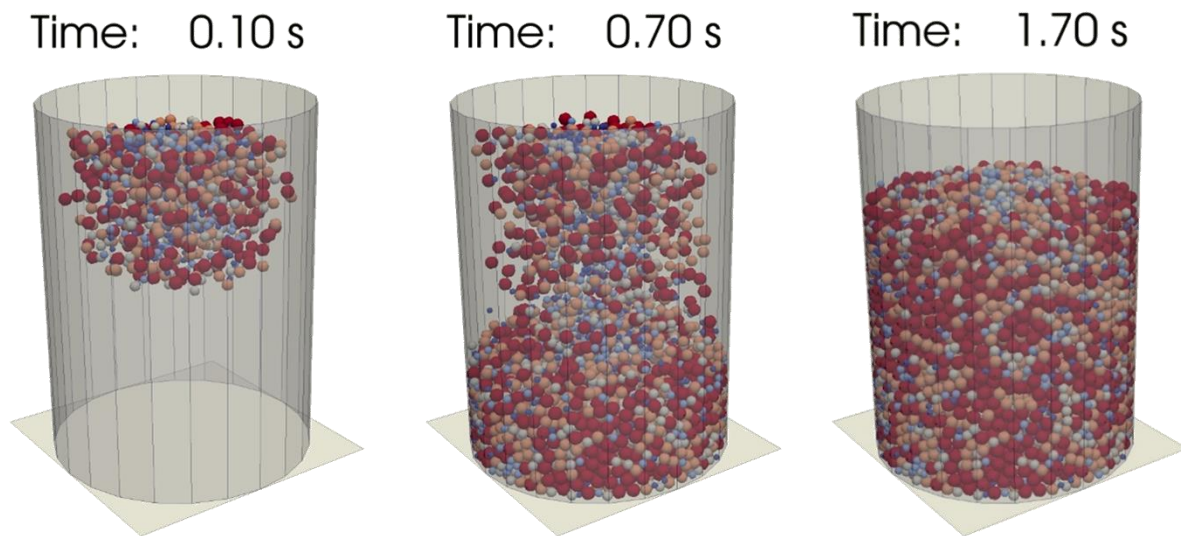Results of this simulation are visualized using ParaView®. Three snapshots of the container during filling process are shown in Figure 1.

Figure 1: Packing of spherical size distribution