**How can we perform multi-physics simulations in industrial powder processes?**

**\*Mikio Sakai**

Resilience Engineering Research Center, School of Engineering, he University of Tokyo, Japan.

\*Corresponding author: mikio_sakai@n.t.u-tokyo.ac.jp

We often encounter multi-physics problems, namely, solid-fluid coupling problems in industrial powder processes. At present, modeling of large scale systems and free surface fluid flows were not established in the simulation of the multi-physics problems. To perform the simulation of large-scale powder systems, we develop a coarse grain model of the DEM. In this model, a modeled large-size particle represents a group of the original ones, where total energy of the modeled particle agrees with that of the original particles. The DEM-MPS method was developed to perform a simulation of a solid-liquid flow involving free surfaces. The DEM-MPS method is a Lagrangian-Lagrangian approach based on a local volume average technique. These models were validated in actual powder processes. Consequently, new models solve the problems related to the simulations of solid-fluid coupling problems.

**Keywords:** DEM, Lagrangian approach, solid-fluid coupling problem, granular flow, multiphase flow