Consultant Feedback

Process System Engineering

Satoru Watano
watano@omu.ac.jp

Osaka Metropolitan University, Japan

Osaka Metropolitan University

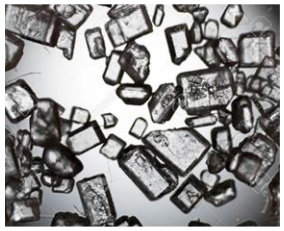
Since April 1st, 2022

Background

In the industrial application, there is a big request for handling of real fine powder with commercial scale.

Most cases, size of fine cohesive powder is ranging between 10 to 100 μm and commercial equipment size is at least 100kg.

Sugar



100μm

Tablespoon(10g)

1 Million

Measuring cup(100g)

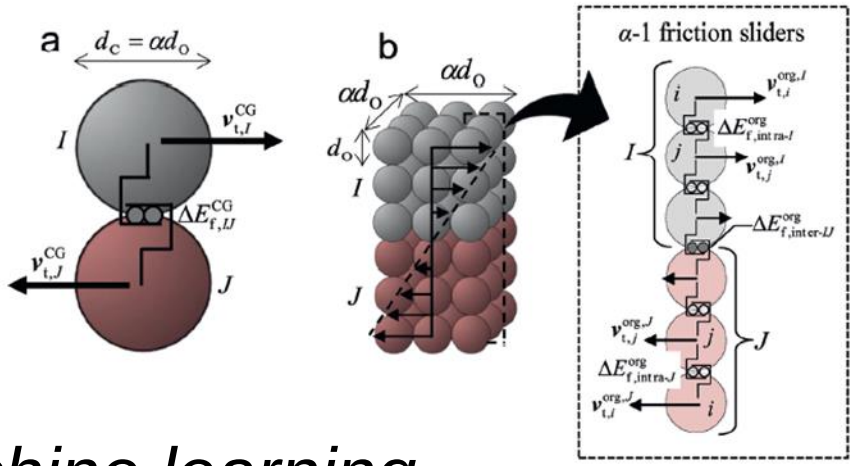
10 Million

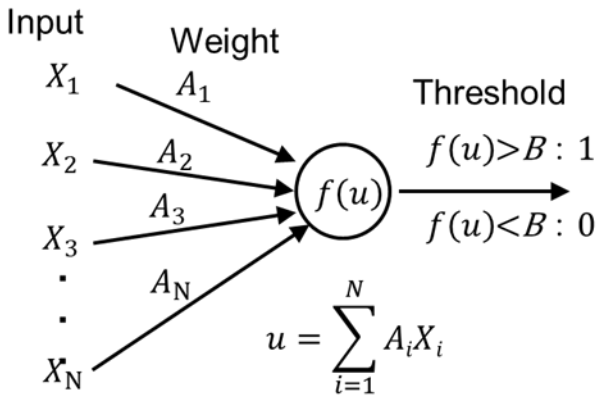
Manufacturing scale (100kg)

1 Billion

Countermeasure for calculation speed-up

- *Coarse grain model*
- *Prediction by using machine learning*
- *Parameter tuning*





Coarse-grained DEM

Multiphase (Gas-solid) flow

Prof. Mikio Sakai
(The University of Tokyo, Japan)

Sakai M., Abe M., Shigeto Y., Mizutani S., Takahashi H., Viré A., Percival J.R., Xiang J., Pain C.C. (2014) Chem. Eng. J. 244 33-43 10.1016/j.cej.2014.01.029
Takabatake K., Mori Y., Khinast J.G., Sakai M.(2018) Chem. Eng. J. 346 416-426 10.1016/j.cej.2018.04.015
Sakai M. (2016) KONA Powder and Particle Journal 33 169-178 10.14356/kona.2016023

Contact dominant granular flow

Prof. Hideya Nakamura
(Osaka Metropolitan University, Japan)

Saruwatari, M., Nakamura, H. Chem. Eng. J. 428. 130969 (2022) 10.1016/j.cej.2021.130969
Kishida, N., Nakamura, H., Takimoto, H., Ohsaki, S., Watano. S. Powder Technol. 390 1-10 (2021) 10.1016/j.powtec.2021.05.028
H. Nakamura, H. Takimoto, N. Kishida, S. Ohsaki, S. Watano. Chem. Eng. J. Adv. 4 (2020) 100050. doi:10.1016/j.ceja.2020.100050.

Cohesive powder flow

Prof. Kimiaki Washino
(Osaka University, Japan)

Hu Y., Chan E.L., Tsuji T., Tanaka T., Washino K. (2022) Powder Technol. 404 117483 10.1016/j.powtec.2022.117483
Chan E.L., Washino K. (2018) Chem. Eng. Res. Des. 132 1060-1069 10.1016/j.cherd.2017.12.033
Washino K., Chan E.L., Tanaka T. (2018) Powder Technol. 325 202-208 10.1016/j.powtec.2017.11.024

Machine learning

Prof. Yansong Shen
(The University of New South Wales, Australia)

Prof. Rohit Ramachandran
(Rutgers, The State University of New Jersey)

Parameter calibration

Prof. Johannes Khinast
(Graz University of Technology, Austria)

Takabatake K., Mori Y., Khinast J.G., Sakai M.(2018) Chem. Eng. J. 346 416-426 10.1016/j.cej.2018.04.015
Sakai M. (2016) KONA Powder and Particle Journal 33 169-178 10.14356/kona.2016023

Prof. Corné Coetzee
(Stellenbosch University, South Africa)

Cietzee C. (2017) Powder Technology, 310, 104-142
Review: Calibration of the discrete element method

Future direction of powder technology

Osaka Metropolitan University

Development of decarbonization and sustainable technologies from the view point system engineering

1. **Cost effective processing**

   Optimum and energy efficient operation, decrease in loss

   Decrease in energy i.e., shift from wet to dry processing

   Desolventizing process i.e. use of alternative solvent, Supercritical CO_2
   Supercritical H_2O

2. **Development of energy storage materials**

   All solid type Lithium ion battery
   Hydrogen storage alloy