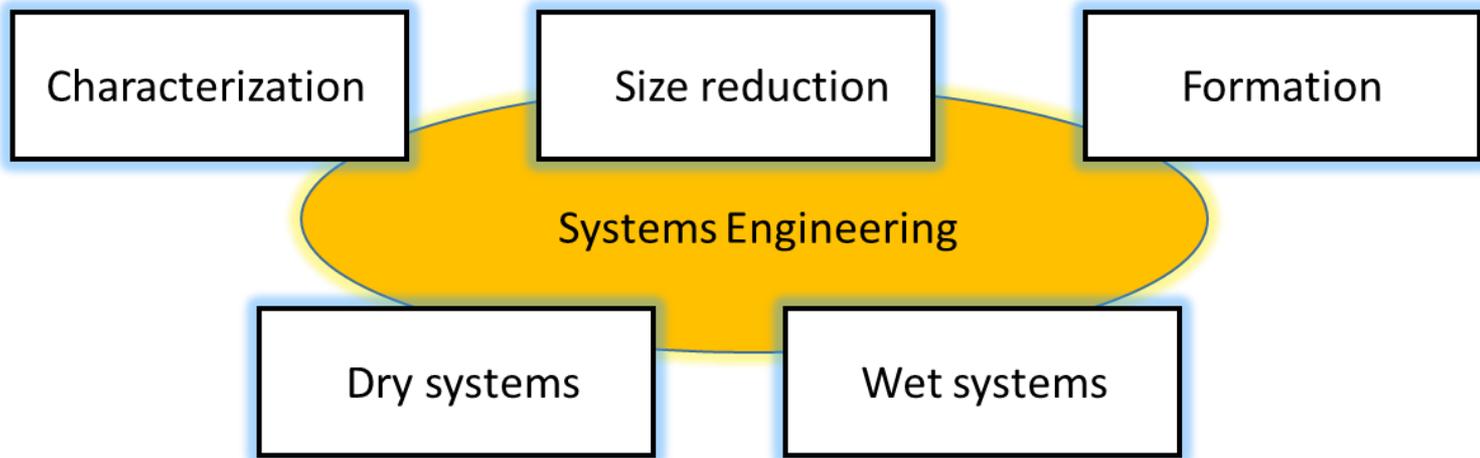


Potential Project from Systems Engineering

Satoru Watano

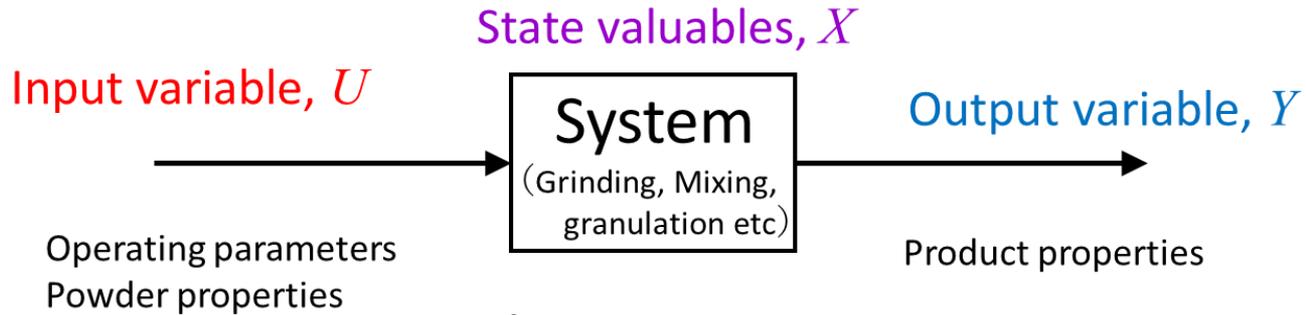
Osaka Prefecture University



IFPRI Current Projects

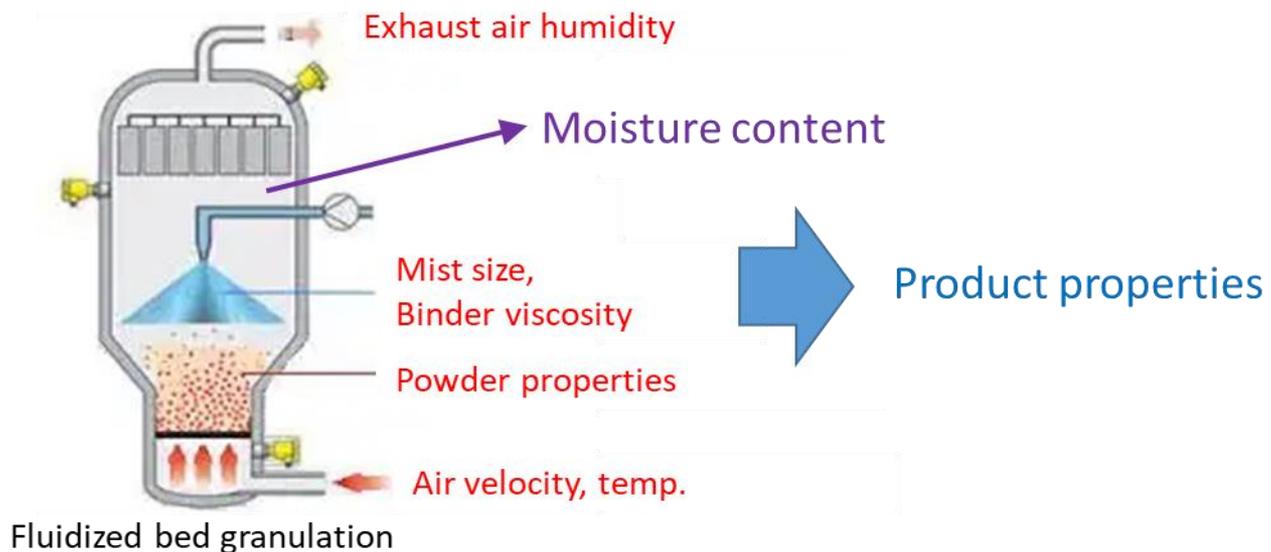
Type	No.	C	SR	F	D	W	SE	Project	Research Associate	Institution	
Projects	1	X				X		Deliquoring of Solvent Wet Filter Cakes	U. Peuker	TU Freiberg	
	2	X			X			Powder Mixing Rules	I. Govender	UKZN	
	3			X		X		Crystal Shape Prediction	M. Doherty	UCSB	
	4	X		X		X		Molecular Self-Assembly	U. Wiesner	Cornell U.	
	5	X			X			Dry Powder Rheology	K. Daniels	NCSU	
	6	X				X		Wetting and dispersion of Powders	C. Gaiani	U. Lorraine	
	7	X		X		X		Characterization of Spray Nozzles at Industrial Conditions	N. Ashgriz	U. Toronto	
	8	X					X	Slurry and Paste Rheology	E. Koos	U. Leuven	
	9			X	X			Powder adhesion to metal surfaces during compaction	C. Sinka	U. Leicester	
	10	X	X	X				X	Model-Based Control of Crystallization	Z. Nagy	Purdue U.
	11	X		X				X	Model-based Design of Granular Products	R. Smith	U. Sheffield
	12	X					X		Simplified Industrial Formulations	J. Vermant	ETH
	13	X	X			X		X	A Systems Engineering Approach to Dry-Milling with Grinding Aid Additives	A. Kwade	TU Braunschweig
	14					X		X	Precision powder feeding	P. Nott	IISc Bangalore
Collab	15										
Other	16				X		X	DEM Roundrobin	J. Seville; K. Windows-Yule	U. Birmingham	

Input /Output Model



$$\begin{cases} \dot{X} = AX + BU \\ Y = CX \end{cases}$$

Equation of state



Conventional topics for systems engineering

1. On-line sensing and control of powder unit operations

- Continuous measurement of particle properties by sensors (X-ray, NIR, laser, image, conductivity, capacitance, acoustic)
- Accurate size measurement for non-spherical particle
- On-line measurement of pressure, stress, force by smart particles
- Control of particle unit operations (grinding, mixing, granulation, coating, drying, crystallization, etc)

2. Optimization, scale-up and analysis of particle unit operations

3. Continuous or hybrid ways of manufacturing of pharmaceutical oral dosage form

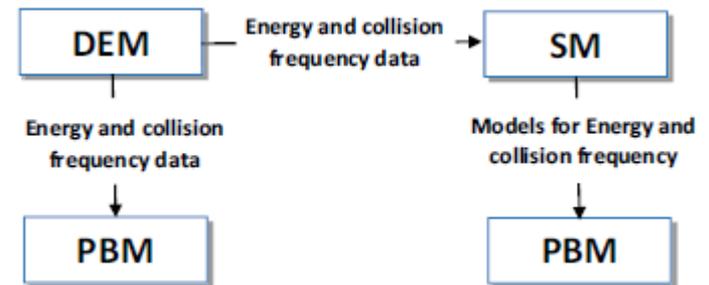
Novel topics for systems engineering

1. Application of DX(Digital transformation) to system engineering

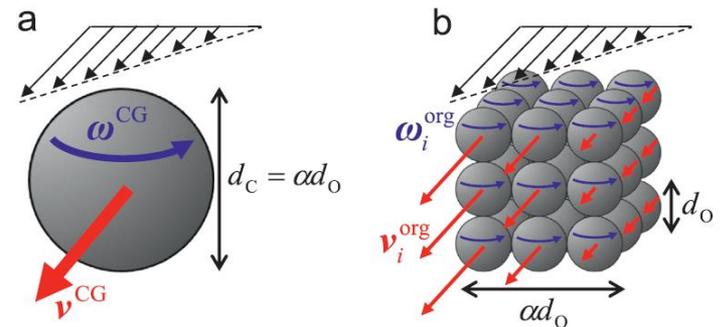
- Use of AI (Artificial Interagency), NN(Neural networks), Big-data for the analysis, scale-up and control of particle unit operations

2. Evolution of numerical simulation

- Development of hybrid simulation DEM-PBM, CFD-DEM-PBM
- Surrogate model based DEM
- AI and NN implemented DEM
- Corse grained DEM
- Practical parameter tuning of DEM



Surrogate model



Coarse grained model

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