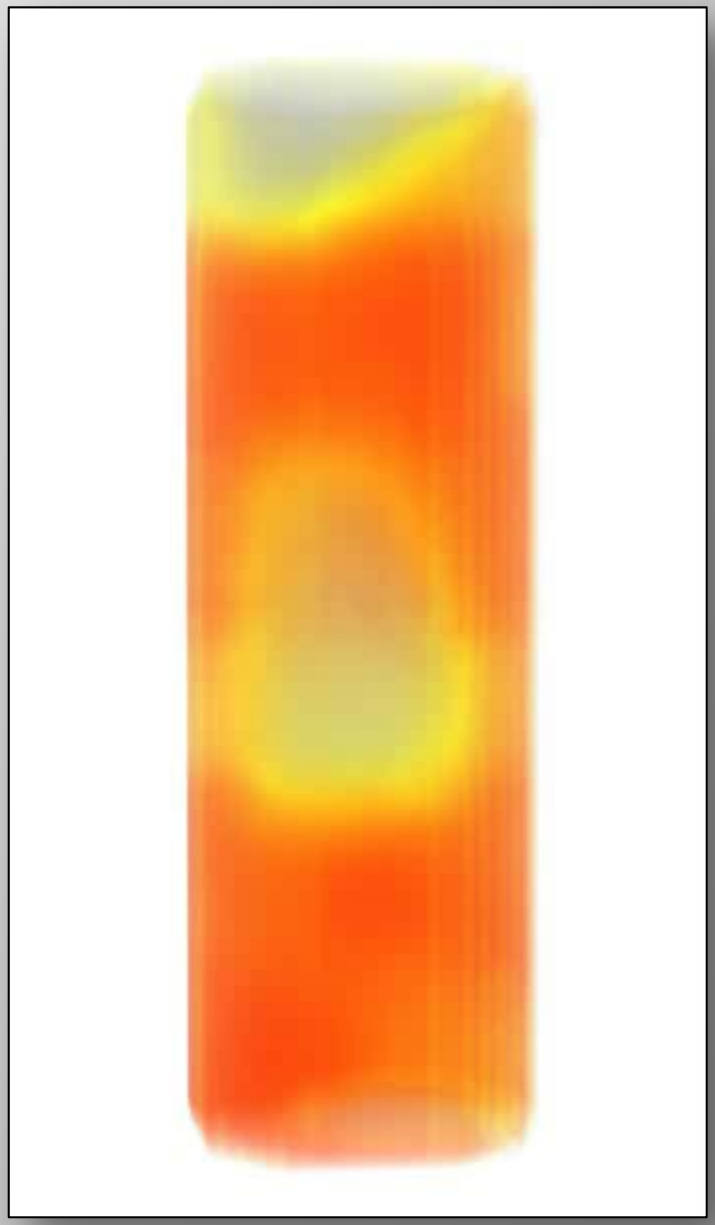
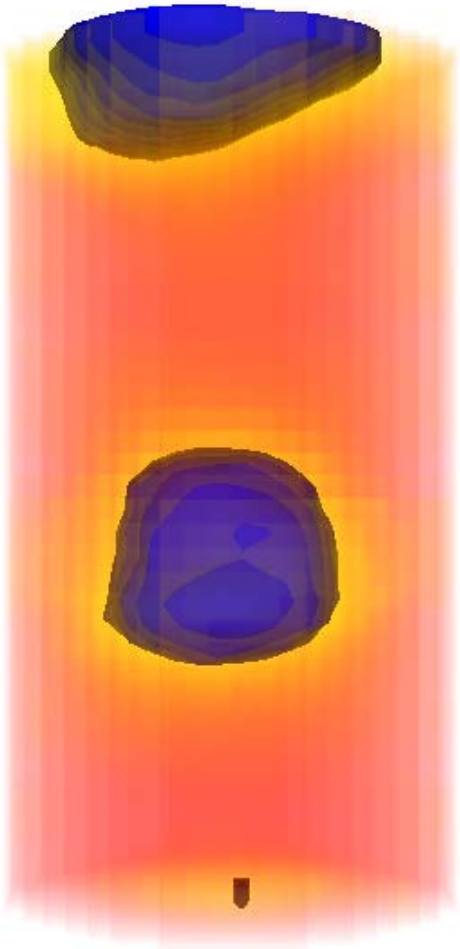
Distributor Plate Modeling with CPFD's Barracuda, Compared to ECVT



Justin Weber, Ky Layfield,
Dirk Van Essendelft, Joseph Mei

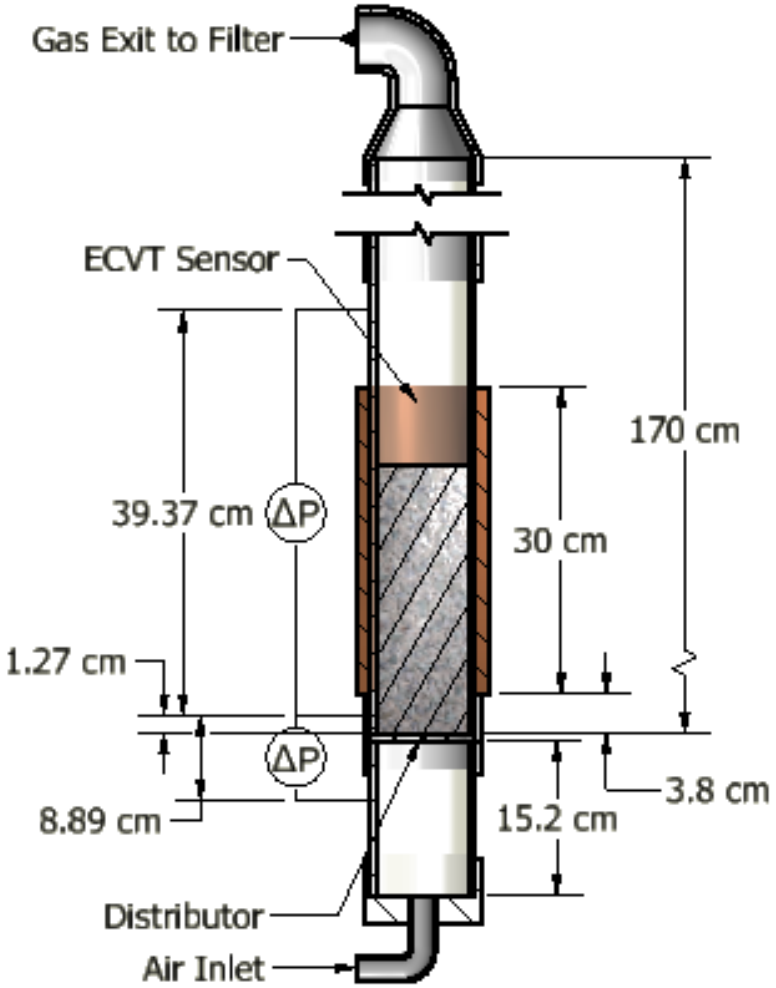
August 7, 2013

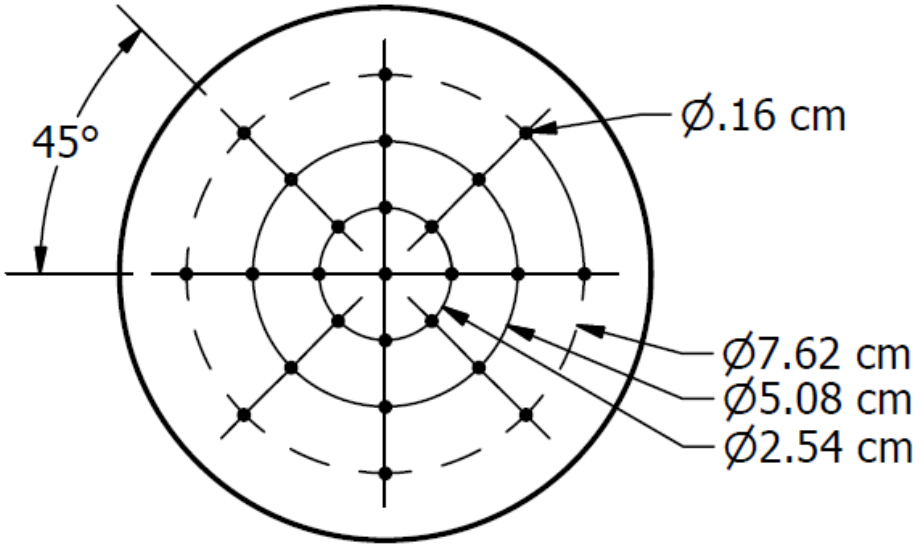
Outline



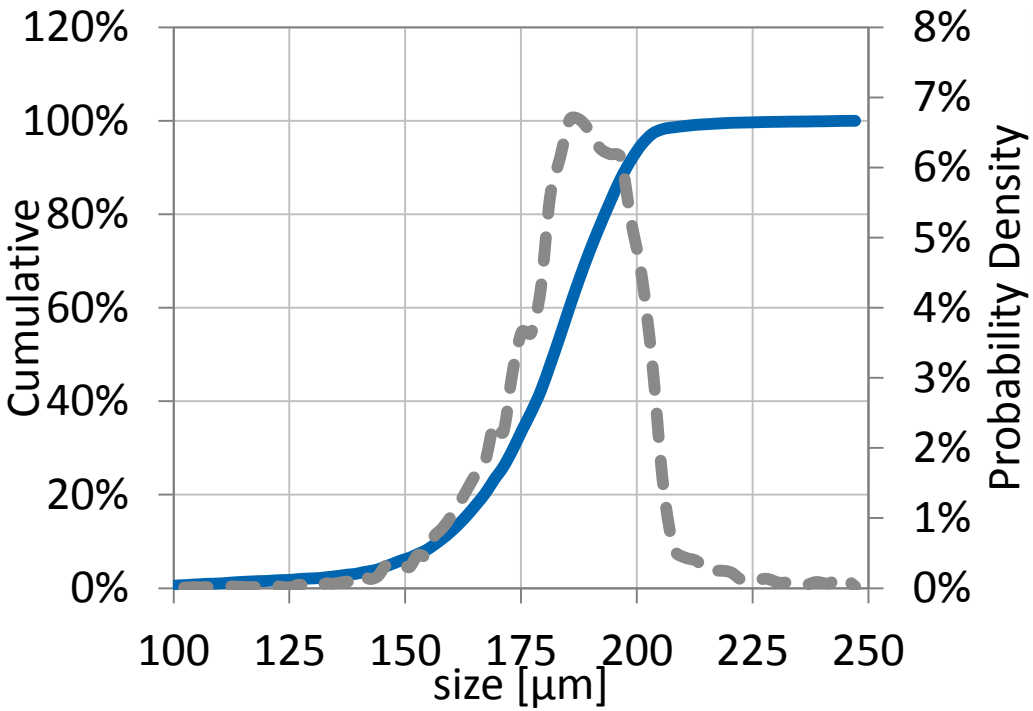
- Experiment
- Electrical Capacitance Volume Tomography
- Computational Models
- Comparison

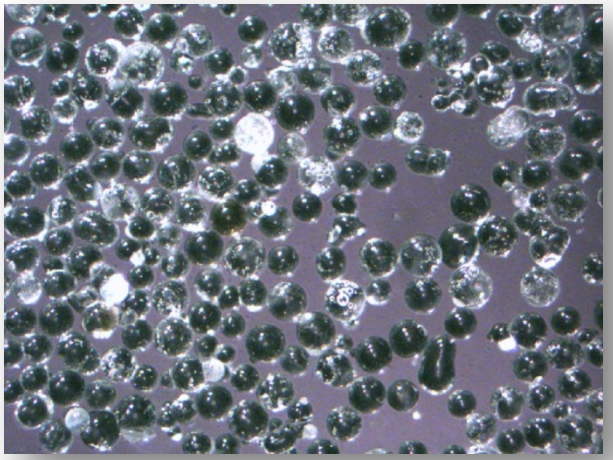
Experiment: Geometry





Experiment: Particles





- Density: 2.48 g/cm^3
- Mean: 185 µm
- Sphericity: 0.98
- U_{mf}: 3.18 cm/s

Static Bed Height: 26.2cm

Ug/Umf=4, or specifically 12.68 cm/s

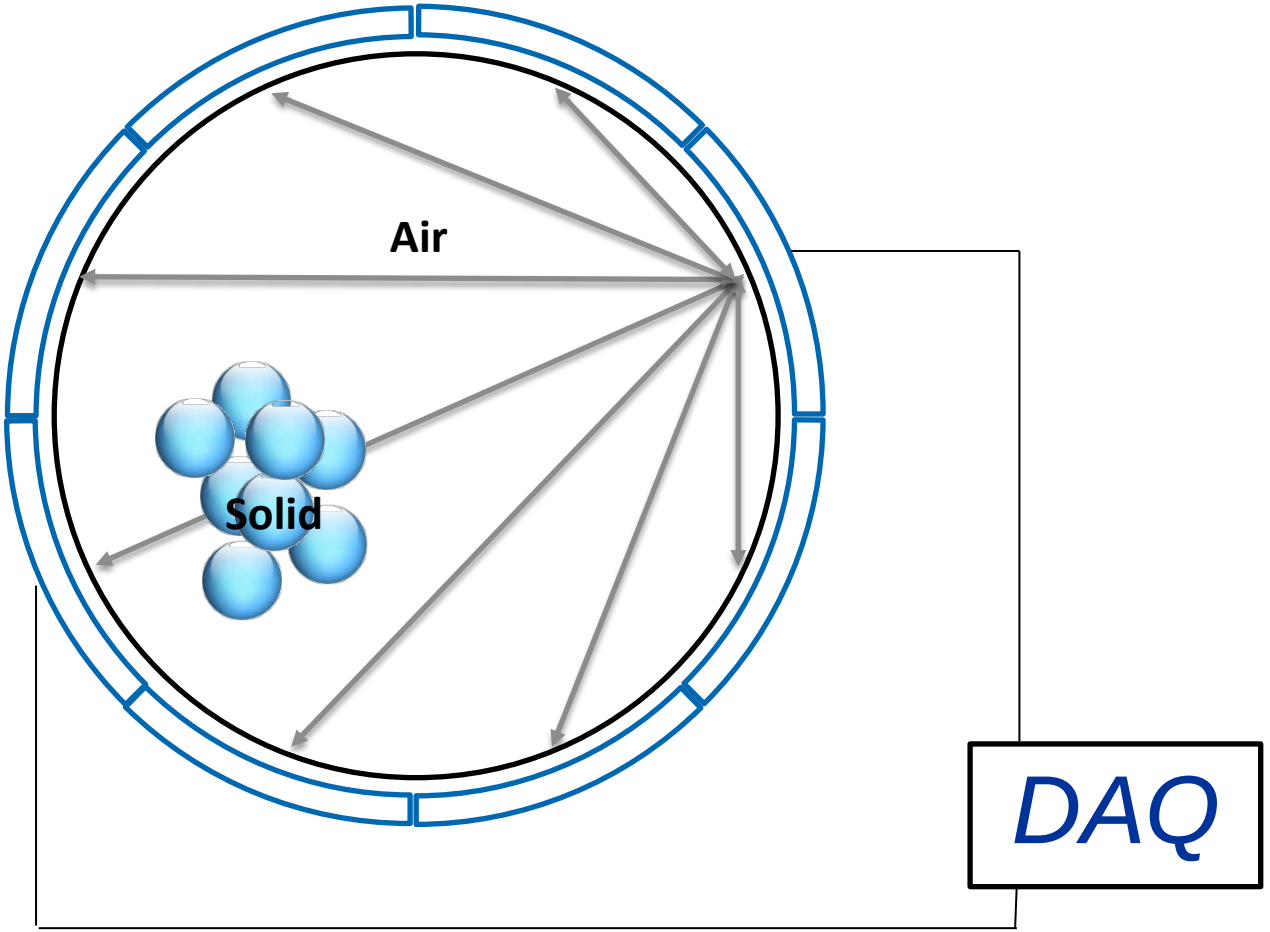
Electrical Capacitance Tomography [ECT]

Relative permittivity

Air ≈1

Polyethylene ≈ 2.25

Glass ≈ 4.7



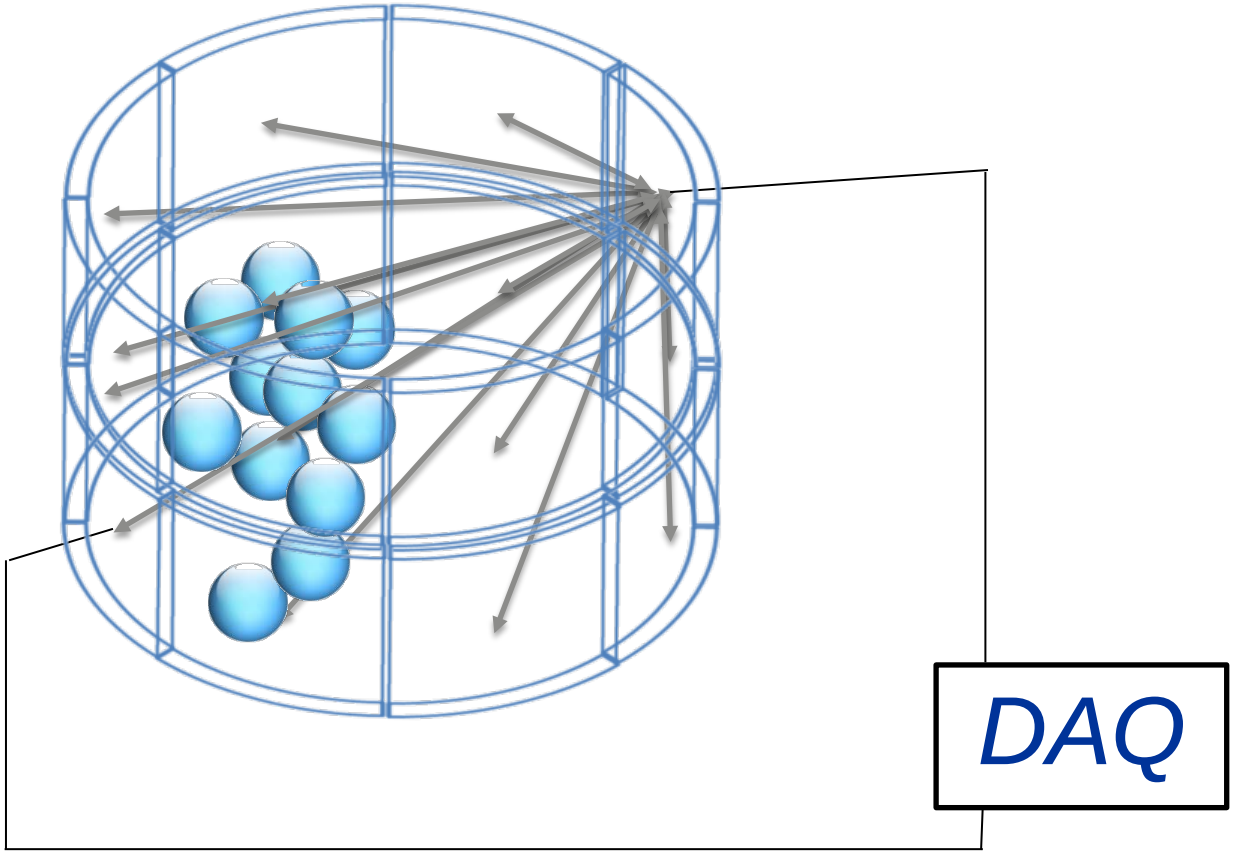
Electrical Capacitance Volume Tomography [ECVT]

Relative permittivity

Air ≈1

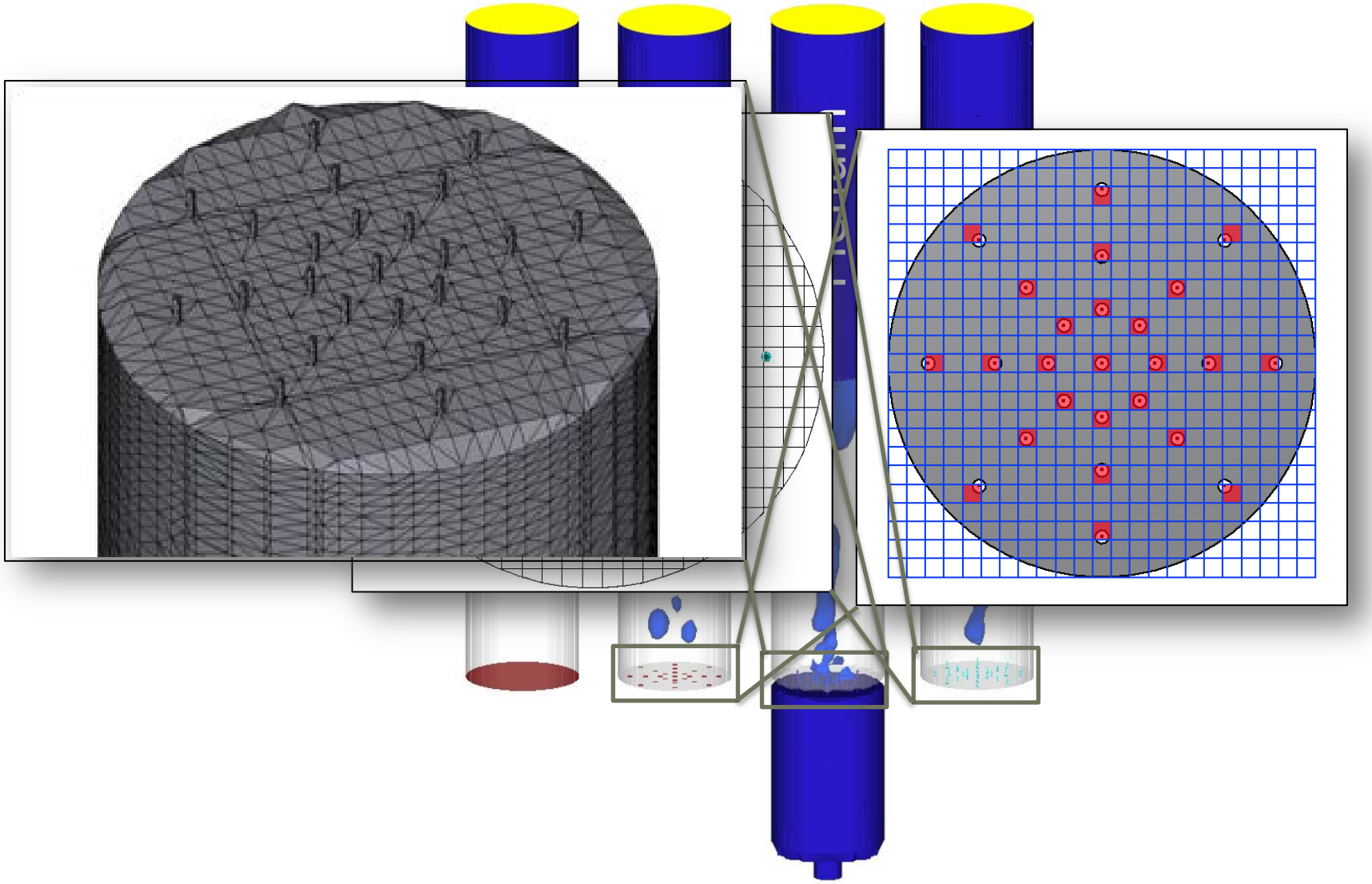
Polyethylene ≈ 2.25

Glass ≈ 4.7

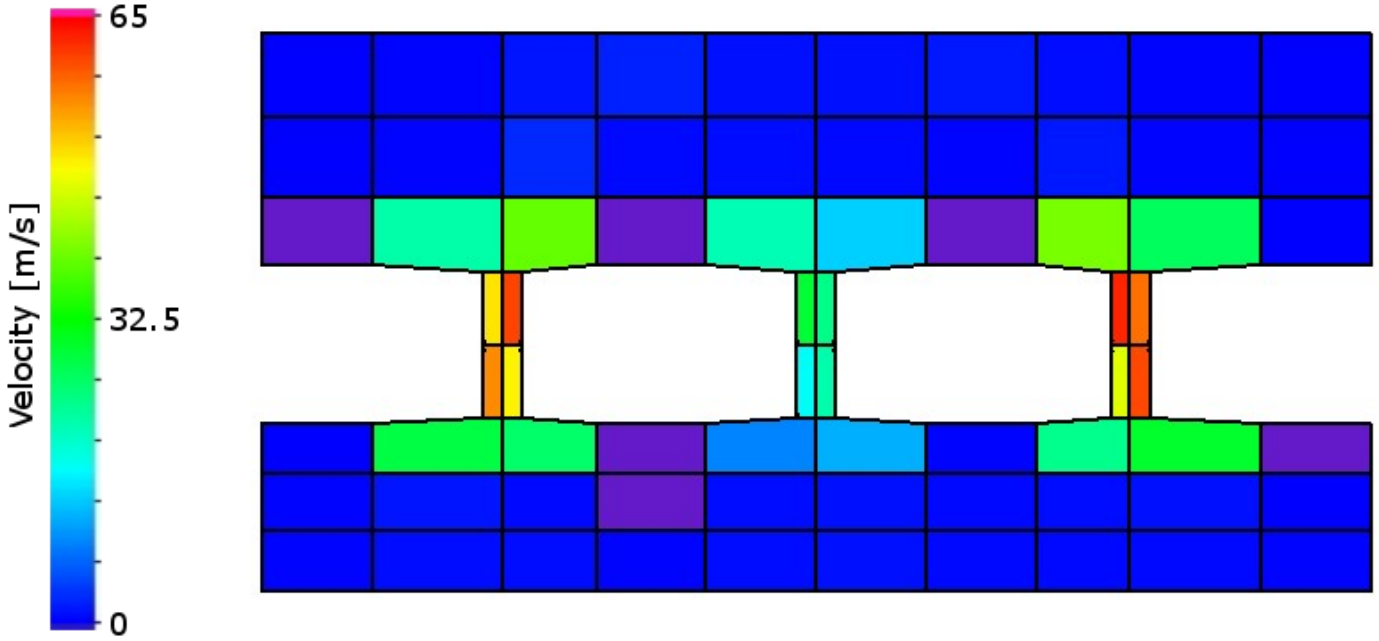


Electrical Capacitance Volume Tomography

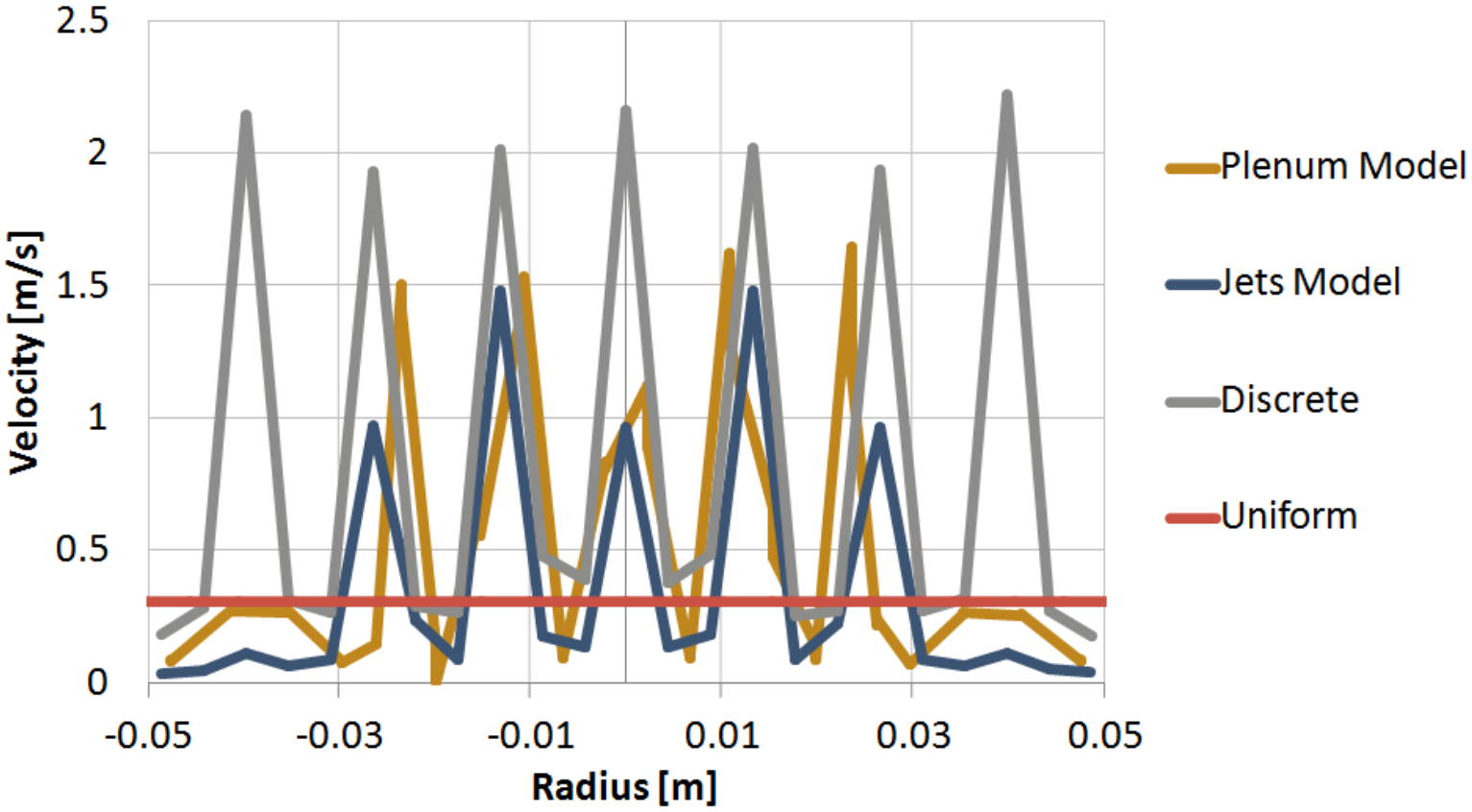
Computational Models



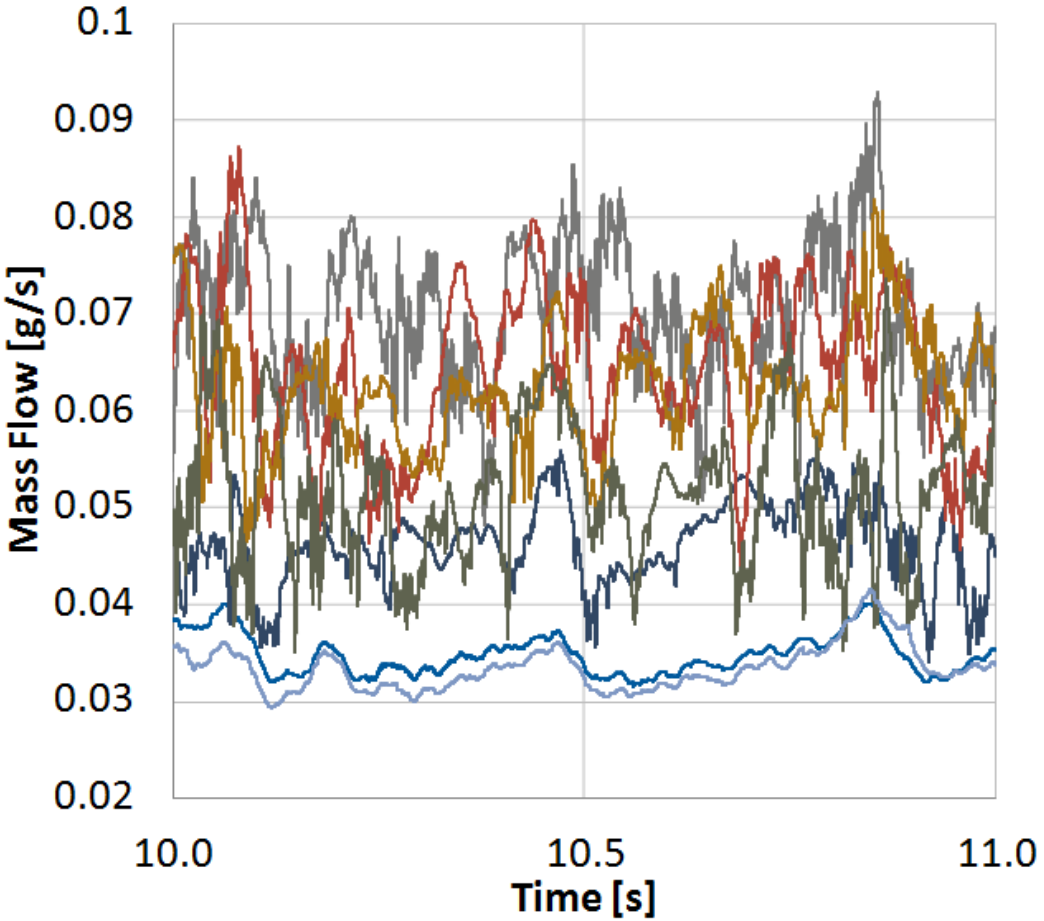
Computational Models

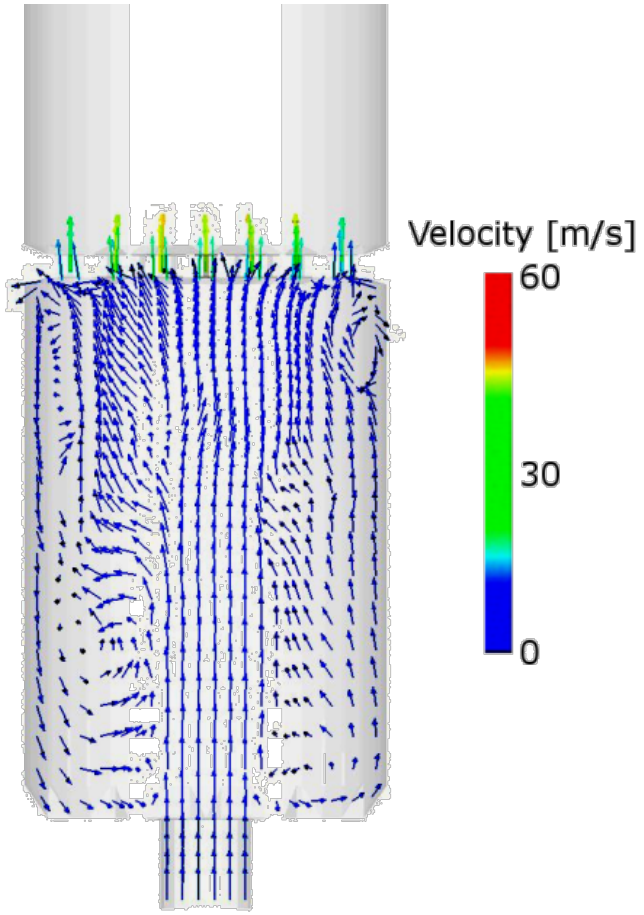


Results: Velocity Distribution

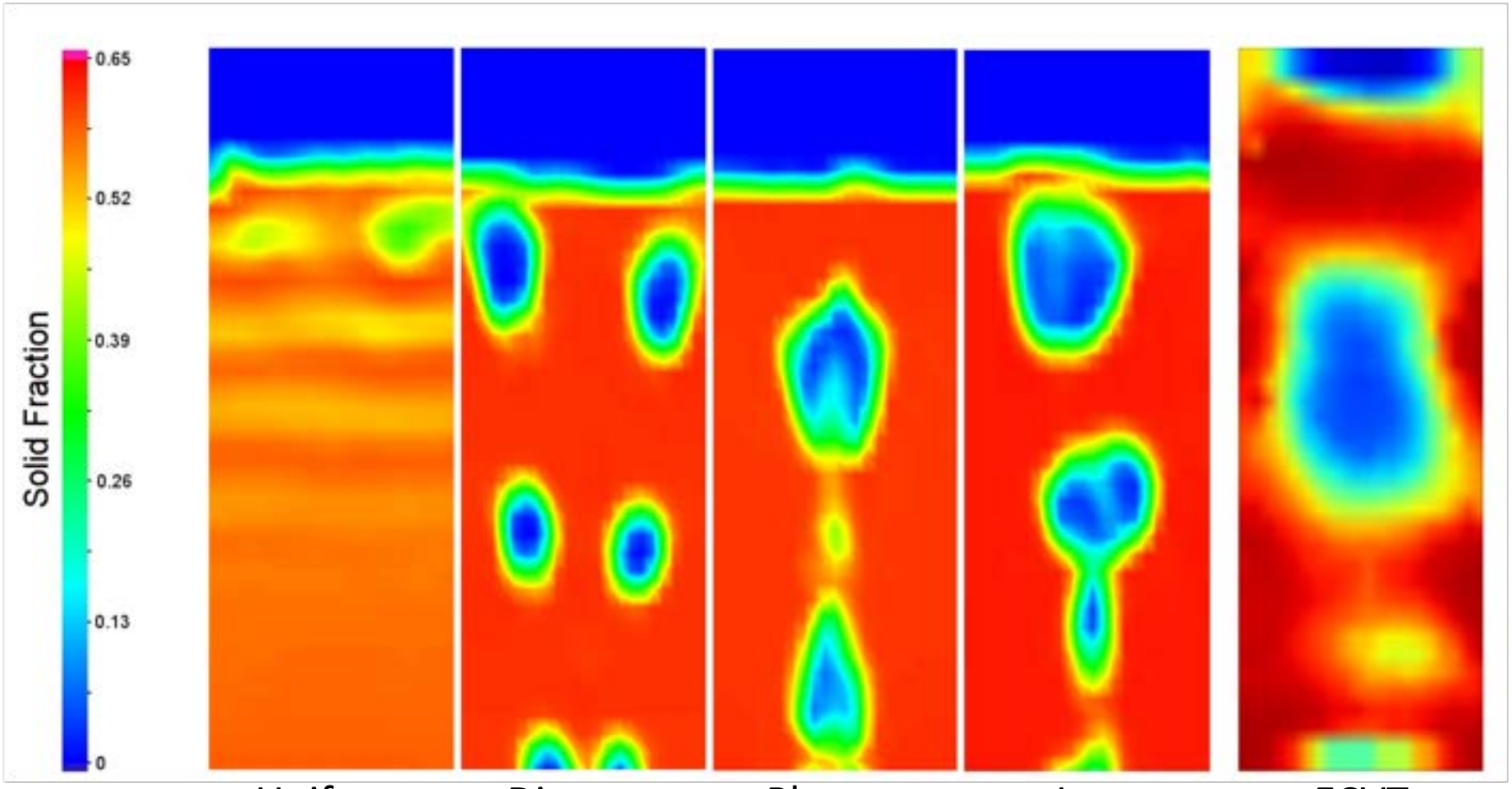


Results: Plenum Mass Flow

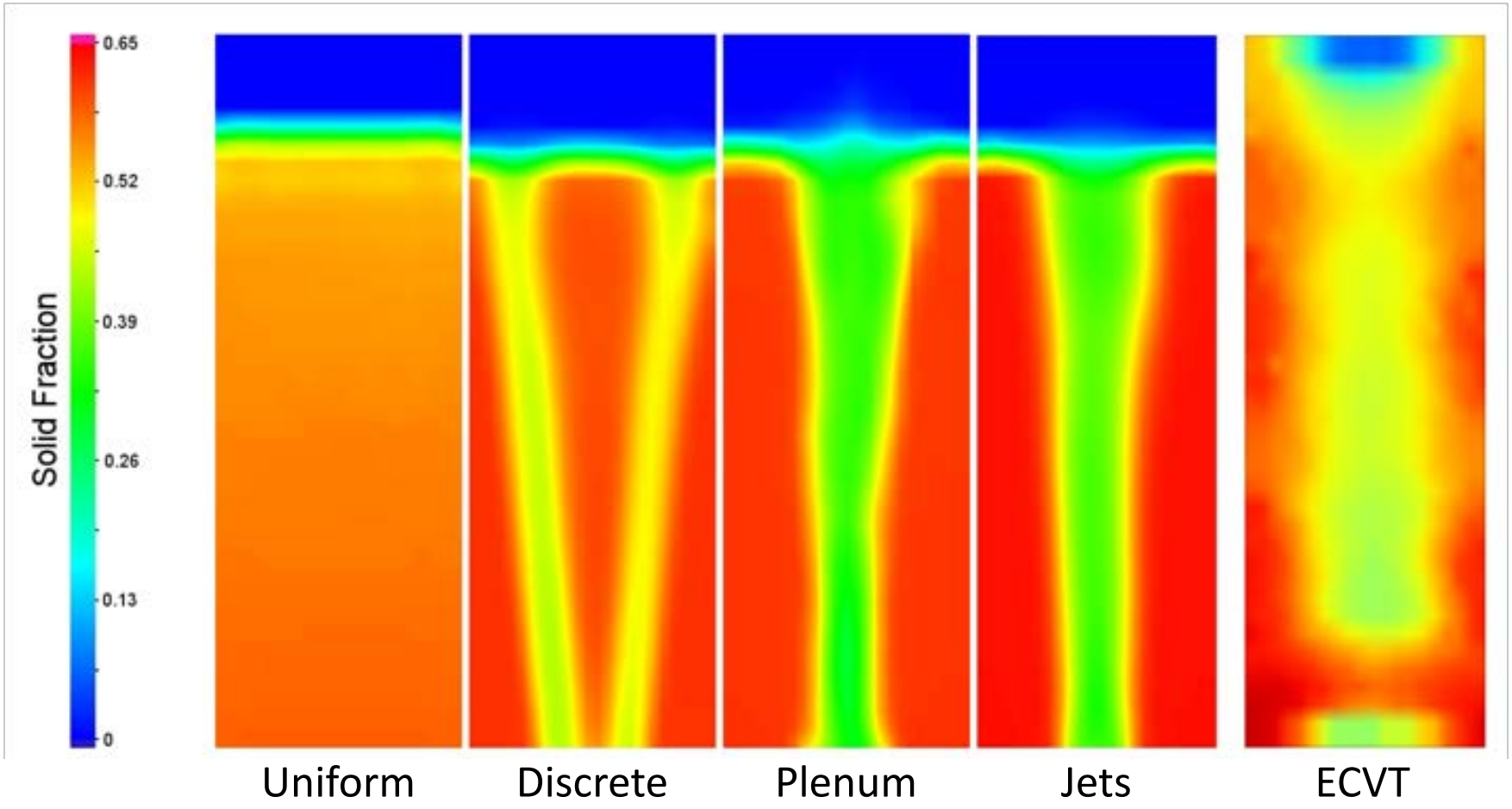




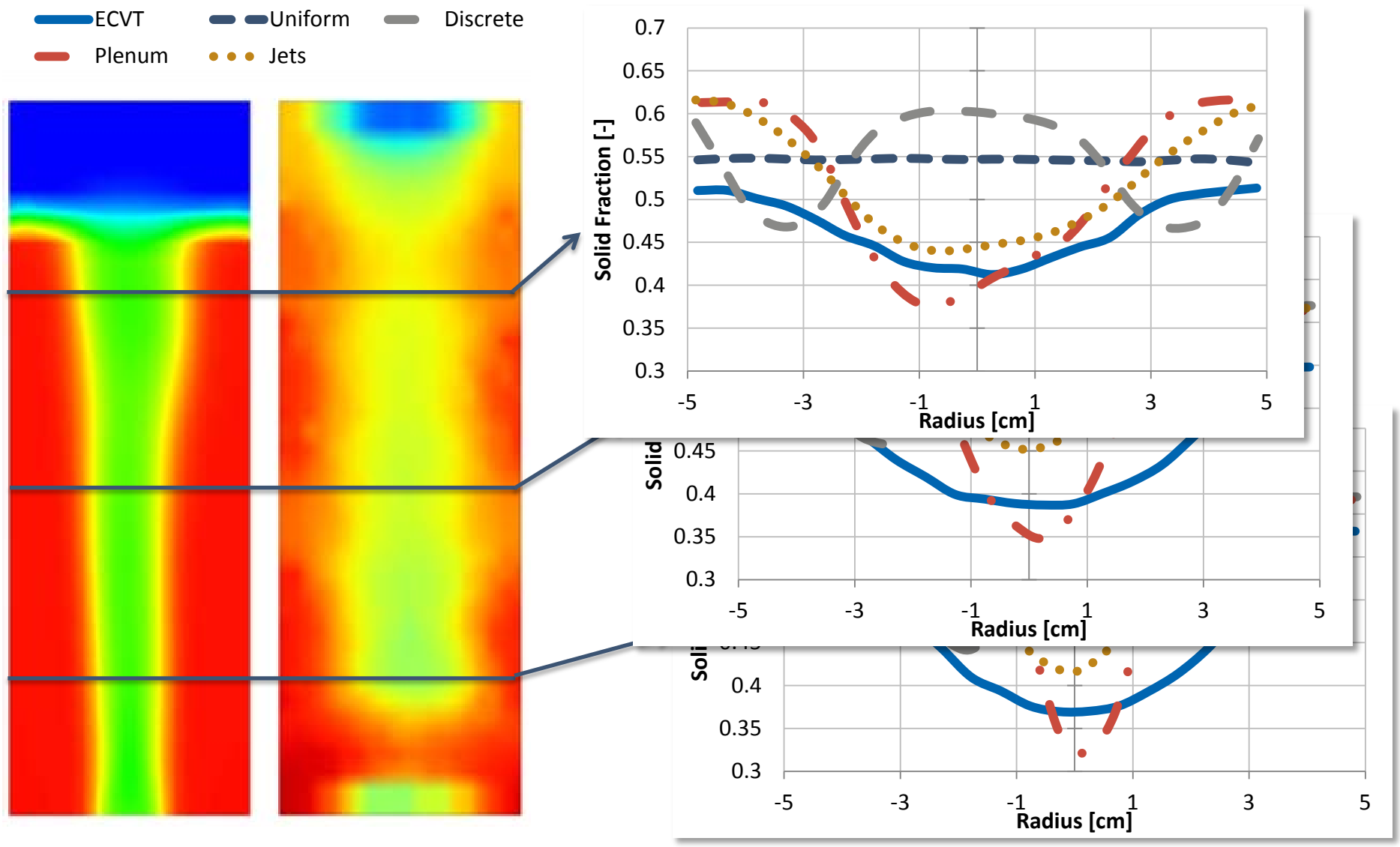
Results Solid Fraction



Results: Time Average Solid Fraction

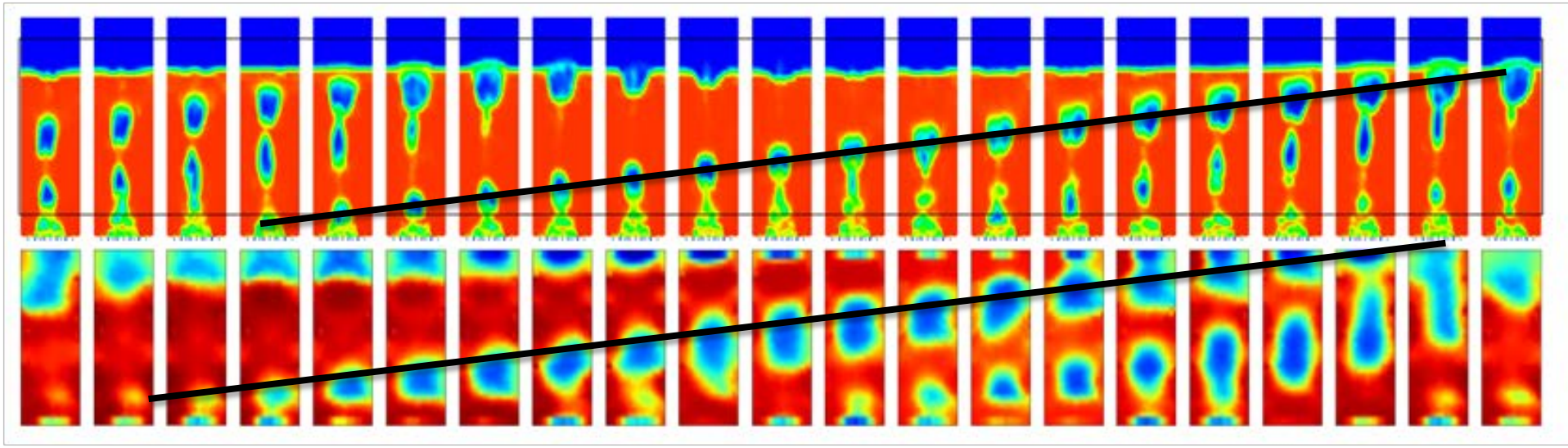


Results: Time Average Solid Fraction



Results: Dynamics

Plenum Model

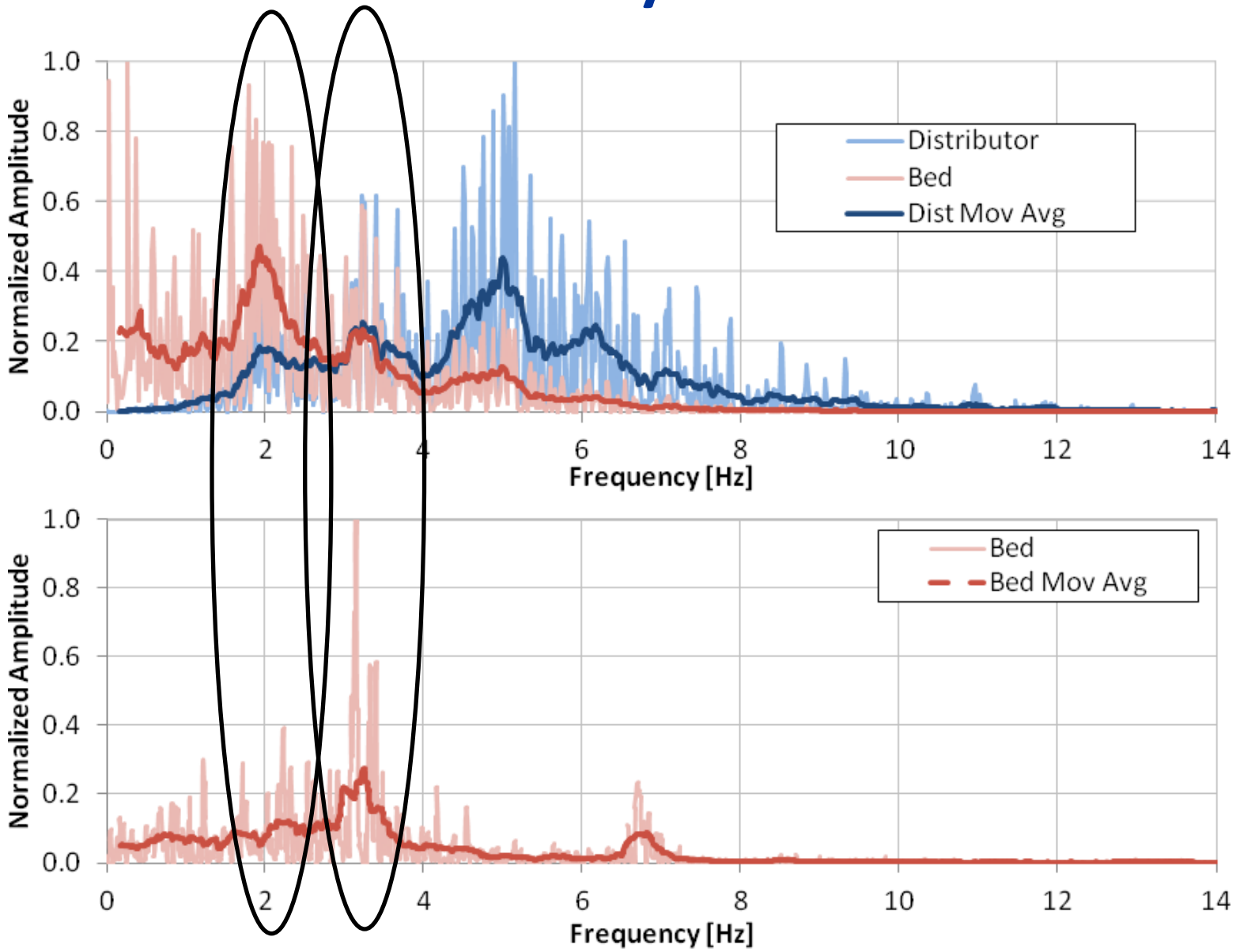


ECVT

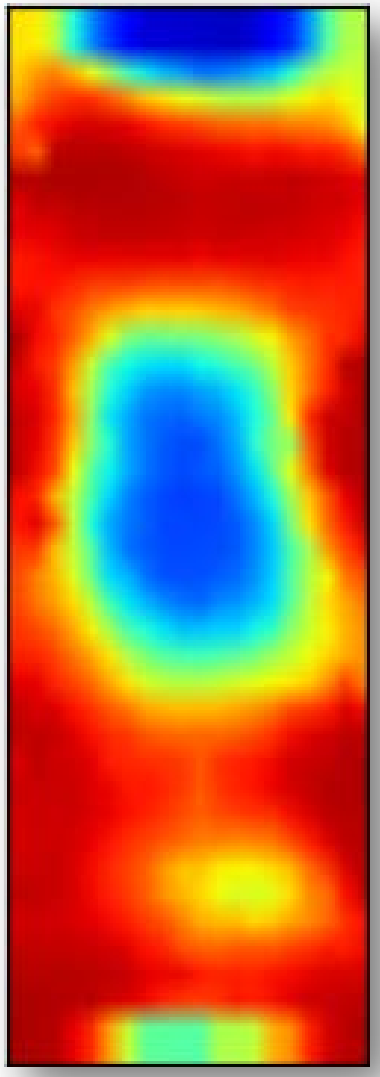
Results: Dynamics

Experiment

Model

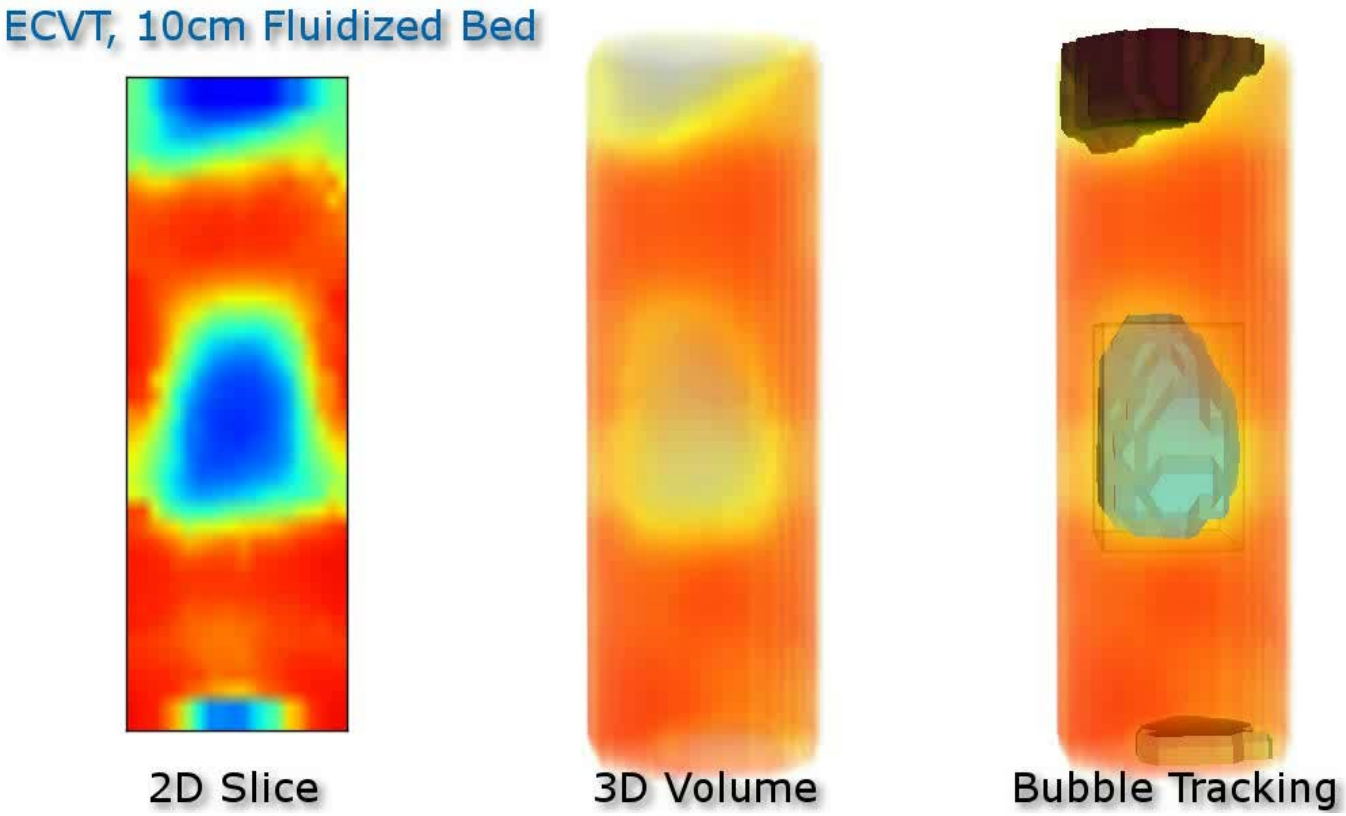


Summary



- Four CPFD Barracuda models were compared to ECVT and high speed pressure transducers.
- The plenum model compared best with the experimental data, however the slowest [1s/day].
- The jets model compared reasonably well, and was significantly faster [30s/day].
- The typical uniform distribution did not perform well at all.

Questions?



Weber, J., Mei, J., "Bubbling fluidized bed characterization using Electrical Capacitance Volume Tomography (ECVT)", Powder Technology, Volume 242, July 2013, Pages 40-50.

Weber, J., Layfield, K., VanEssendelft, D., Mei, J., "Fluid Bed Characterization Using Electrical Capacitance Volume Tomography (ECVT), Compared to Computational Particle Fluid Dynamics's (CPFD) Barracuda", Powder Technology. - **Submitted**

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Backup Slides

Model	Grid	Cells (Fluid)	Particles (Clouds)	Computation Time	Average Time Step
Uniform	20x20x65	26k (22k)	61M (0.5M)	63.5s/day	2.98×10^{-3}s
Discrete	23x23x65	34k (28k)	62M (0.6M)	21.7s/day	2.24×10^{-3}s
Plenum	22x22x107	52k (45k)	62M (0.8M)	0.98s/day	4.01×10^{-5}s
Jets	23x23x64	33K (30k)	62M (0.6M)	29.9s/day	2.80×10^{-3}s

		Models			
	Experiment	Uniform	Discrete	Plenum	Jets
Distributor	931	NA	NA	1115	NA
Bed	3880	3982	3963	3652	3996