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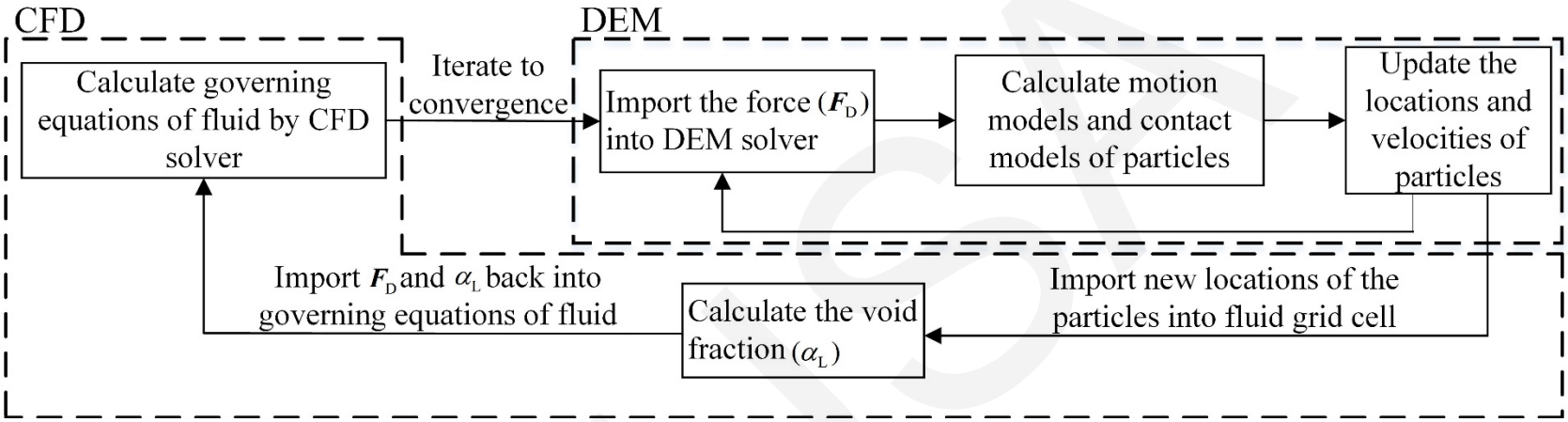
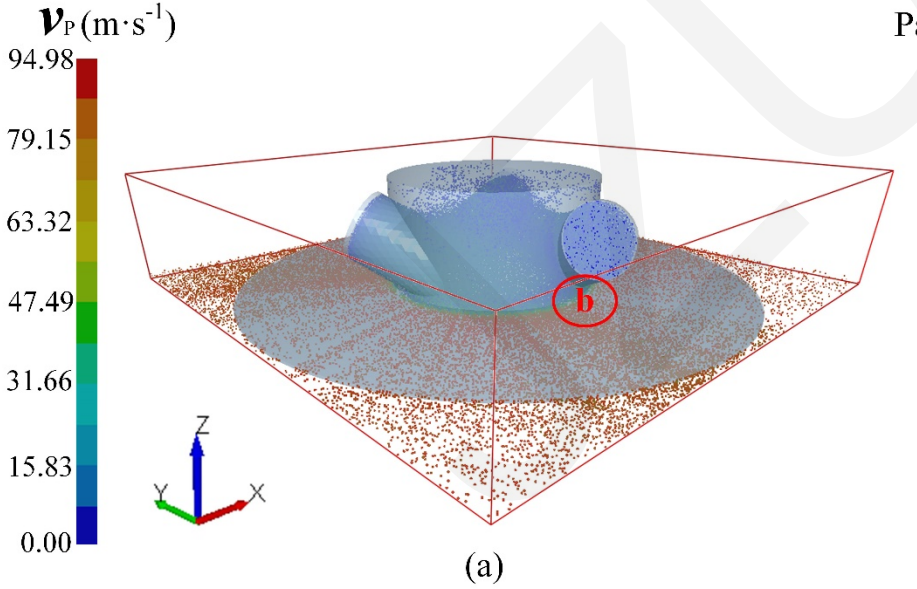
Wall contact effects of particle-wall collision process in a two-phase particle fluid

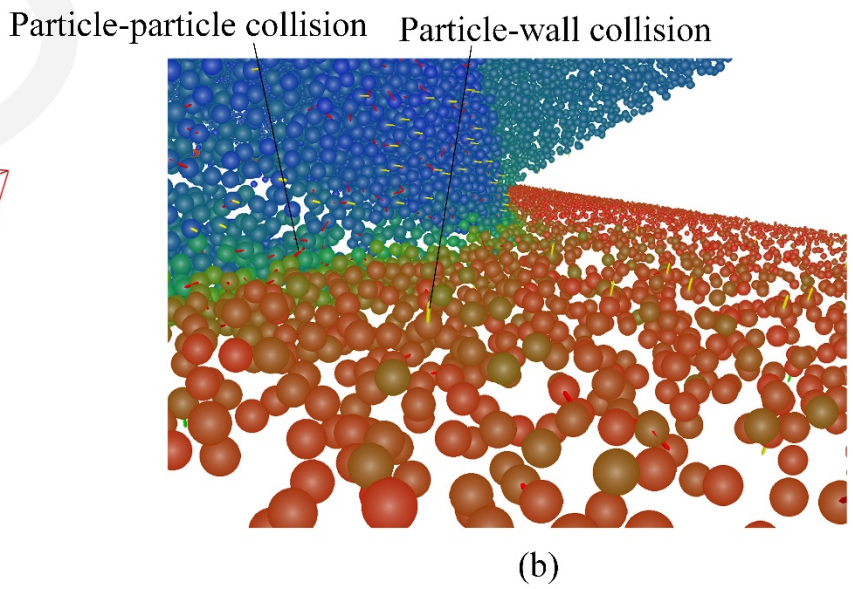
Key words:
Wall contact effects, CFD-DEM, Particle-wall collision, Two-phase particle fluid

CFD-DEM coupled modeling method





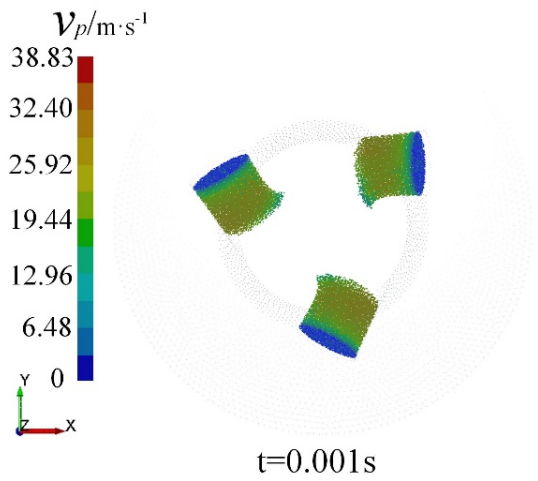
(a)



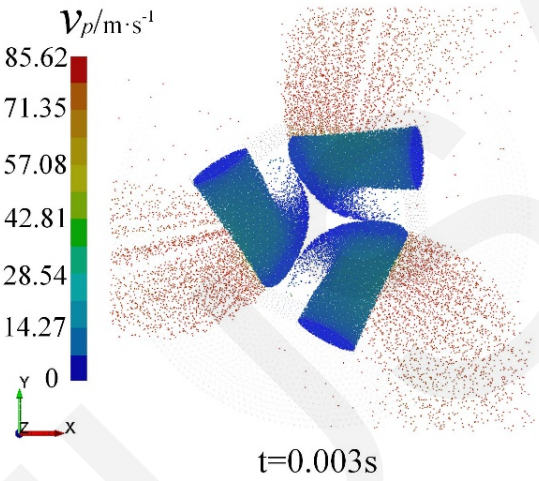
(b)

Axis view of macroscopic particle fluid (D = 20 mm, μ = 0.005 kg/m·s, t = 0.01 s) (a) global view (b) partial enlarged view

Macroscopic velocity profiles of particles



t=0.001s



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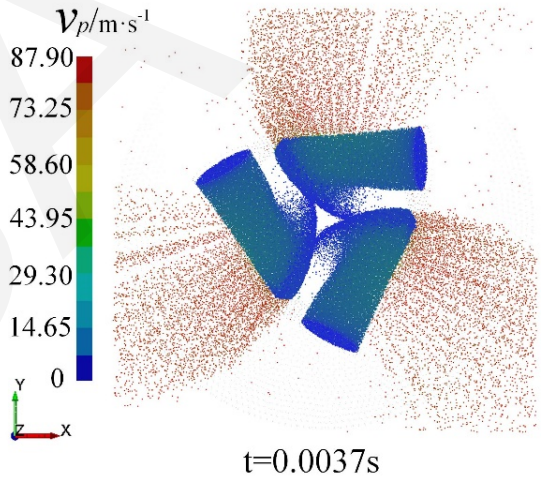

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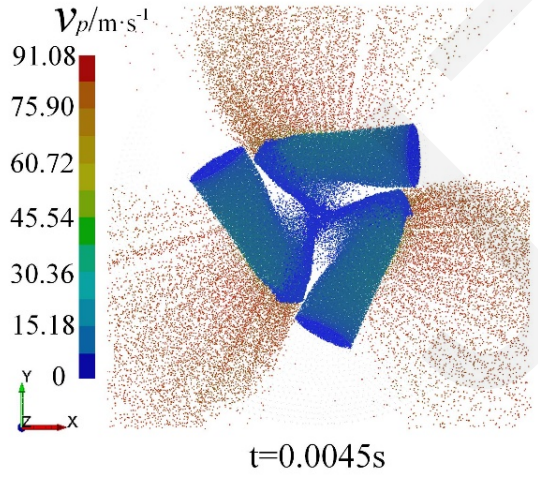

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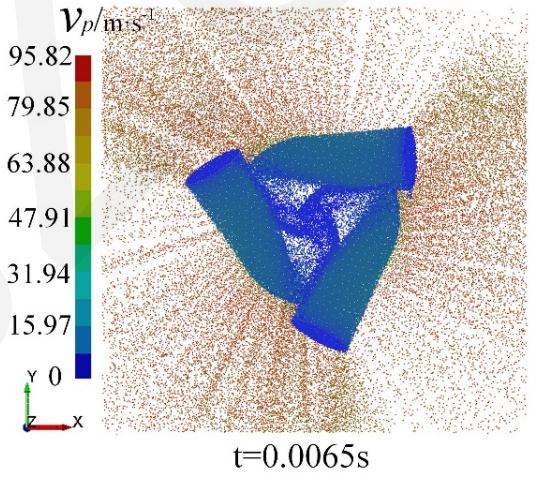
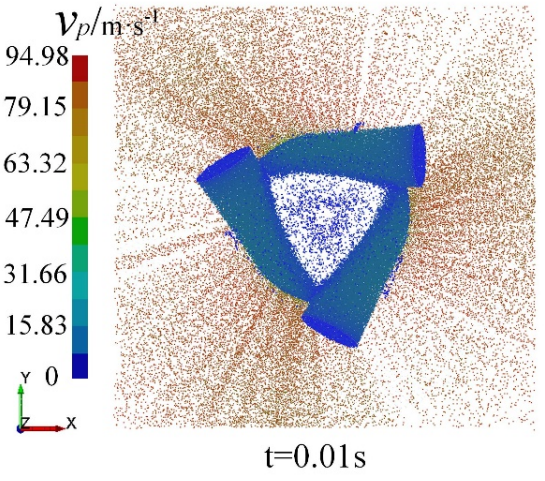
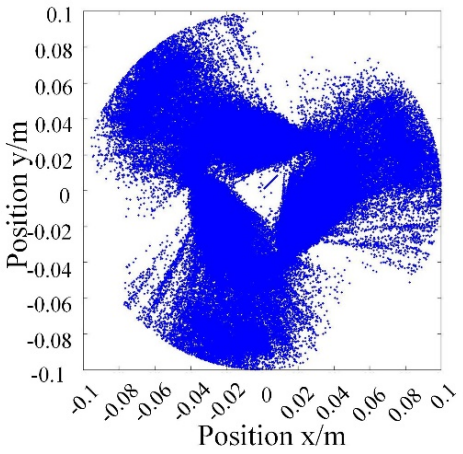


t=0.0065s

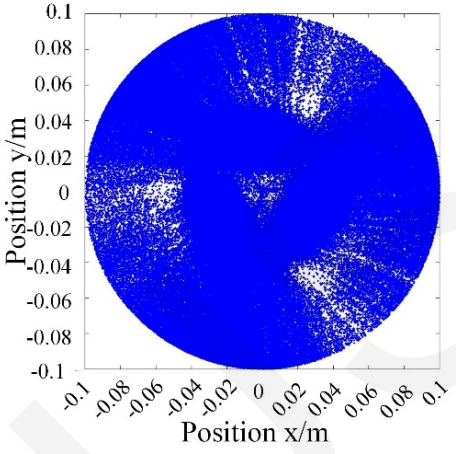


t=0.01s

Contact point distributions for different inlet diameters



D=13mm



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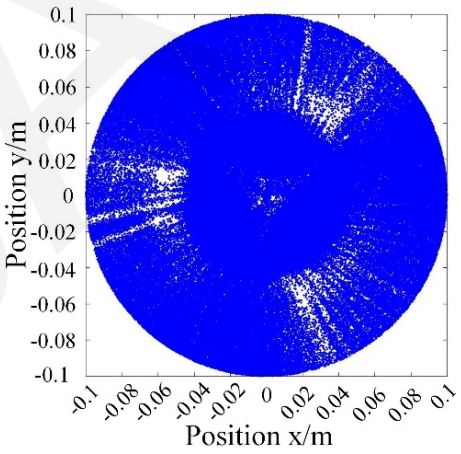
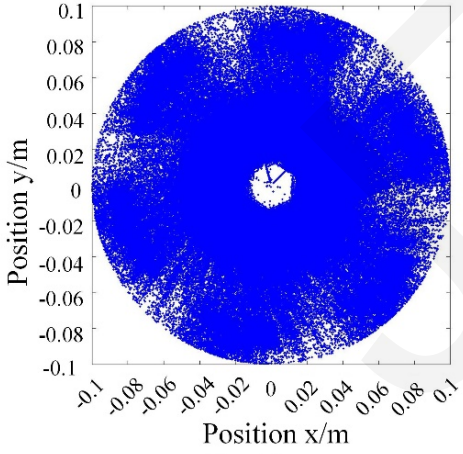


D=27mm



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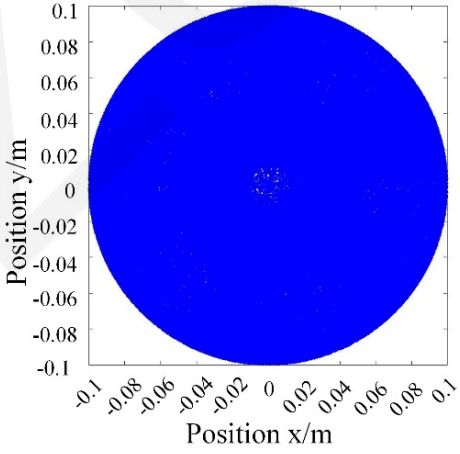
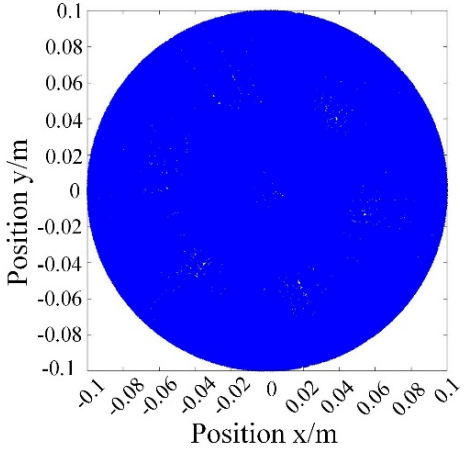
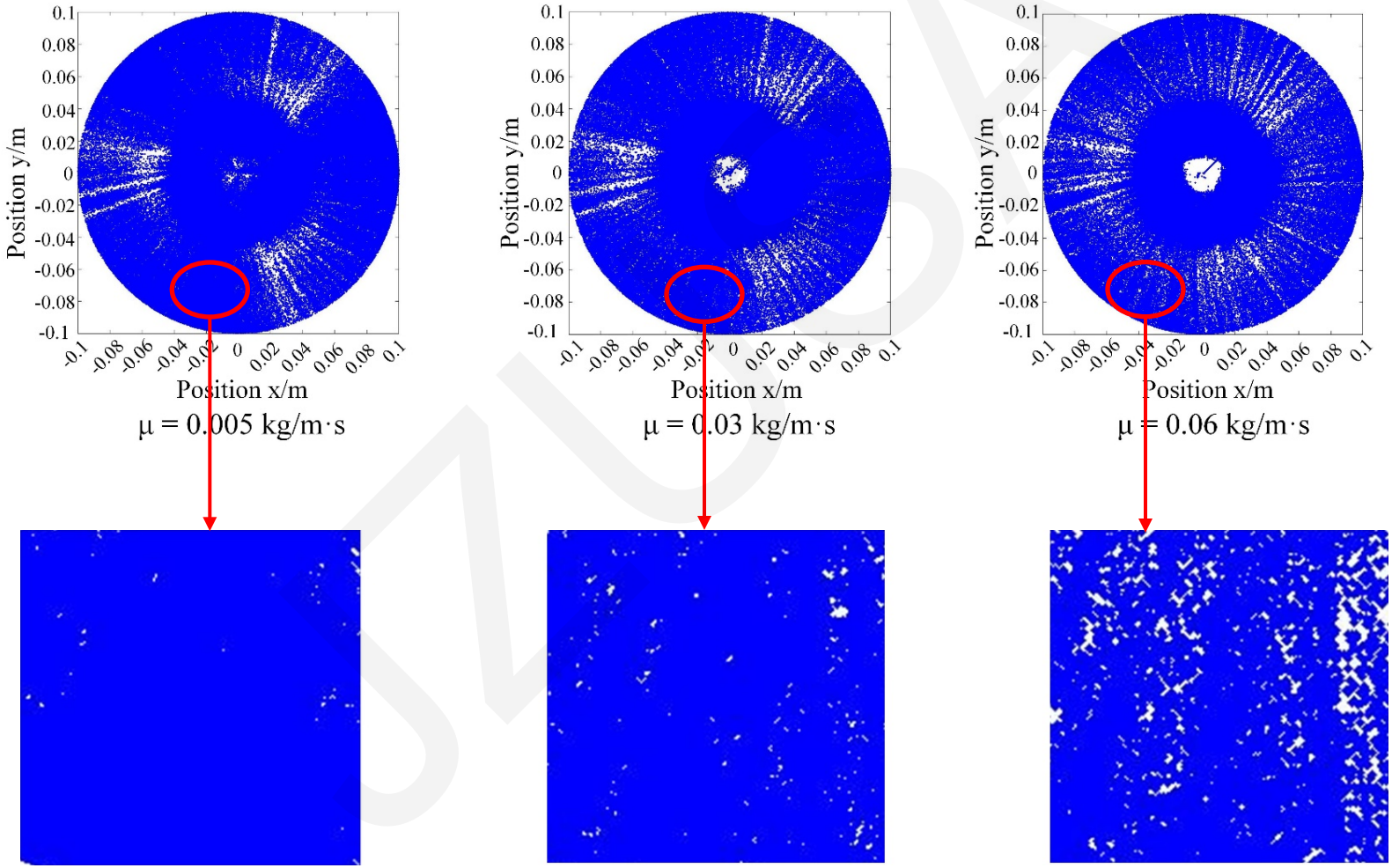


D=20mm

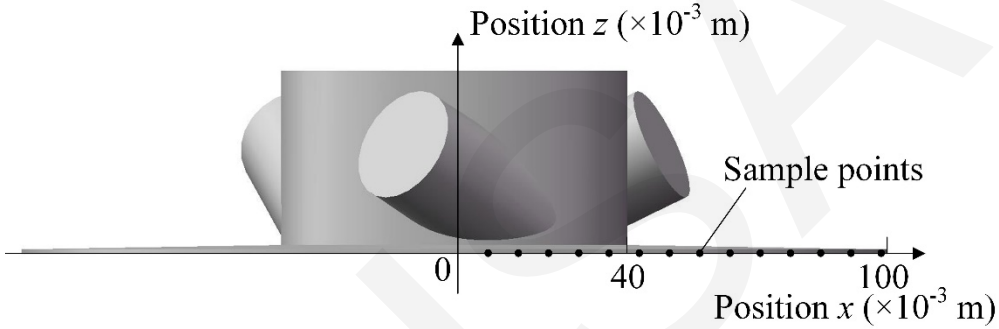


D=27mm

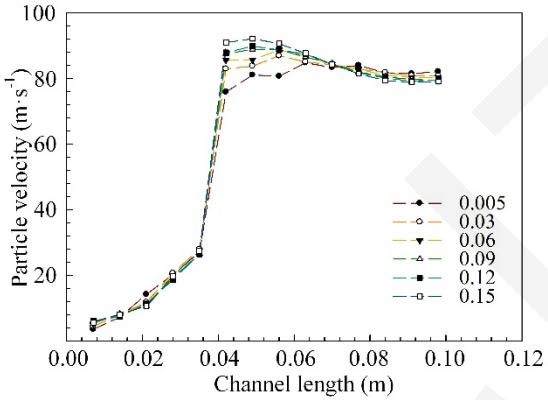
Contact point distributions with different viscosities



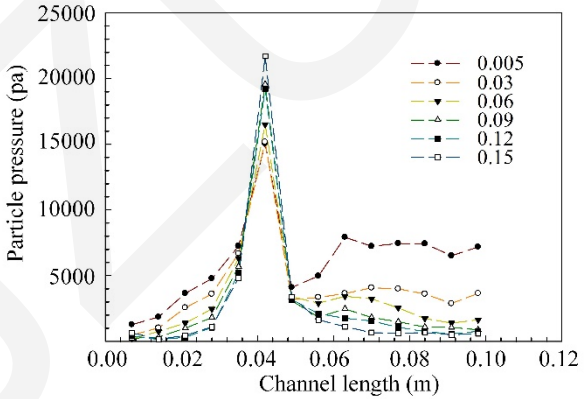
Contact effects for different inlet diameters



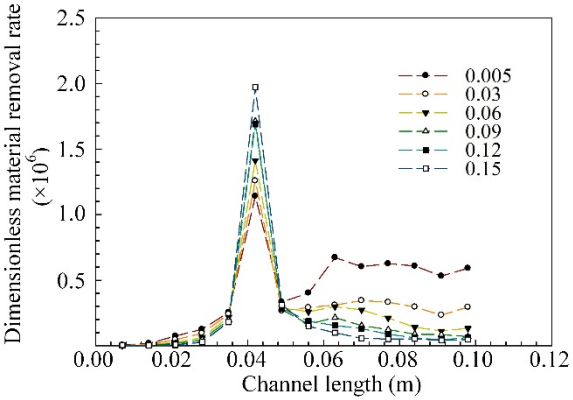
Sample points on the wall



Particle-wall collision velocity distributions

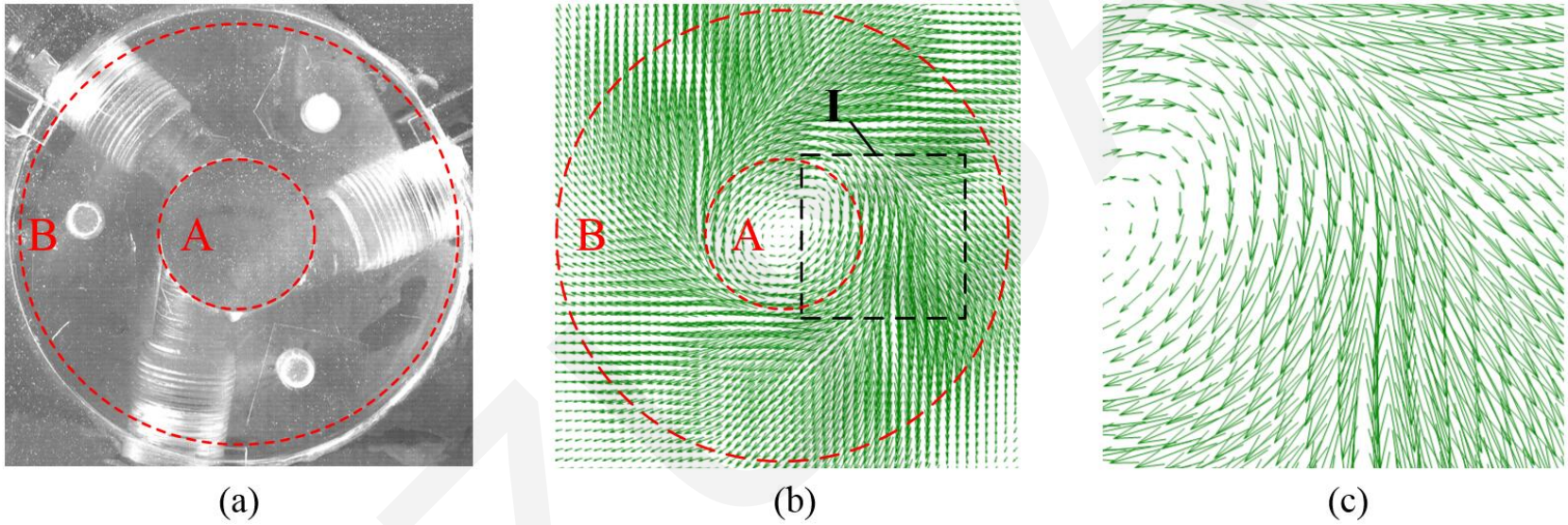


Particle-wall collision pressure distributions



Material removal rate distributions

PIV validation experiments



(a) (b) (c)

PIV observation experiments: (a) observation flow passage; (b) average velocity vector profile on the wall; (c) partial en-larged view of I

Conclusions

- An inter-phase coupling solution method for parti-cle-wall collision is proposed; accurate motion laws of the particle-wall collision process are obtained, and the mechanism of wall contact deformation and material removal can be revealed.

- There are radial texture phenomena on the profiles of particle trajectories caused by the flowing interference of the particle fluid ; when D = 20 mm, the contacting point distribution with rotating superposition reaches the best uniformity; the higher viscosity can carry more particles, and the transporting ability of the fluid medium is improved; if the fluid flowing direction is parallel to the wall, the particle-wall collision pressure and collision velocity mainly depend on the turbulent motion of the fluid, and decrease with increase of fluid viscosity; the uniform contact effects can be more easily performed by the low viscosity fluid.

- By means of PIV method, the real particle velocities are obtained, and the effectiveness of the proposed modeling method can be validated.