Test case calculations and examples of application

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Whenever new approaches and new models are developed in the frame of macro-scale simulations on the basis of Euler/Euler or Euler/Lagrange approaches a validation is essential. Such a validation may be based on either DNS or LES results or detailed experiments. Depending on the multiphase flow system considered, such experiments may provide integral information (i.e. pressure drop or gas-hold-up) or local information on the carrier and dispersed phase. This could be for example velocity fields (by PIV: particle image velocimetry) or profiles (by LDA: laser-Doppler anemometry), which depends on the measurement technique applied (see, e.g. Crowe et al. 2012, Sommerfeld and Tropea 1999). In many processes the development of particle size distributions also is of great importance, especially if for example coalescence of droplets (sprays) or bubbles are relevant. Then measurement techniques are required which also resolve a particle size distribution as for example phase-Doppler anemometry (PDA) in sprays (Rüger et al. 2000) or complex flows with particle separation (Sommerfeld and Qiu 1993) or high resolution imaging techniques in bubbly flows (Sommerfeld and Bröder 2009). Important for all measurements is the specification of possible experimental errors or confidence levels. Crucial for a numerical calculation are also the proper specification of the inlet conditions of both phases, such as mean velocity profiles and fluctuating velocities and particle or droplet size distributions. In confined flows also wall collision parameters need to be provided.

Since many dispersed two-phase flows are rather complex and a number of different particle transport processes are involved it is suggested to select test cases with dominant transport processes which are relevant for the considered validation. For example when anticipating the validation of turbulent dispersion models one should select experiments on the dispersion of particles in well-defined turbulence (i.e. grid-generated turbulence or pipe flow). The modelling of inter-particle collisions may be validated based on fluidized bed experiments and calculations with wall collision models should consider experiment in all bounded flows such as pipes and channels. For validating droplet evaporation models it should be tried to consider very dilute sprays where droplet collisions are rare (Sommerfeld et al. 1993). Droplet collision and coalescence models may be validated considering experiments on two interacting sprays.

ERCOFTAC has established two data bases where a few multiphase flow cases are included:

http://qnet-ercoftac.cfms.org.uk/w/index.php

http://cfd.mace.manchester.ac.uk/ercoftac/index.html

Other test cases for dispersed multiphase flows may be requested from:

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References

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