Numerical simulation of rising bubbles with and without mass transfer by means of the Volume of Fluid (VOF) method

Abstract of the dissertation by Mario Koebe

In addition to experiments, numerical simulations offer a great chance for closer investigation of local phenomena in two-phase flows.

The simulations presented in this thesis were performed by the CFD code *FS3D* which is based on the Volume of Fluid (VOF) method. The validation of the hydrodynamics is done by experimental data for form-stable bubbles and by analytical solutions for creeping flows. A good agreement is observed.

The simulated rise velocities of air bubbles in water for high Reynolds-numbers show a good quantitative agreement with the experiments over a wide range of bubble diameters. Rise paths and dynamic bubble shapes agree qualitatively well with measurements. Experimental observations of wake phenomena can be confirmed by simulations.

With an extended version of *FS3D* it is possible to calculate mass transfer across dynamical deformed interfaces. Real concentration jumps across the interface can be rendered by the simulations. Concentration wakes which form behind single bubbles and bubble chains as well as mass flow rates across the interface show a good agreement with experimental data.