

# **Multiphase transition capabilities in ANSYS Fluent**

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## **Abstract**

Multiphase flows exist in many natural and industrial processes, i.e., power generation, process systems, or environmental control. Depending on phases, velocities, and volume fractions, various flow patterns may be present. These require different modeling approaches.

Interface-tracking schemes can be used when two or more immiscible fluids are present with a clearly defined interface. Common problems in that category are initial jet breakup and large bubbles' motion in liquid or free-surface flows. When interface length is small compared to a computational grid, Euler-Euler multiphase approach is recommended, e.g., bubble columns, coating processes, or fluidized beds. In cases of dispersed flows, Lagrangian-tracking models can be used.

Problems arise in transitional flows, where there is a need for intermediate scales and seamless transition. ANSYS Fluent contains such approaches as Algebraic Interfacial Area Density Model (AIAD), developed by the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) and ANSYS. This model differentiates between bubbles, droplets, and the free surface interface. It can be used in the case of wave flows with high superficial gas velocity. Entrainment and absorption mechanisms are present, and model capabilities can be extended via the population balance approach. Another modeling approach that is available in Fluent is called GENTOP (Generalized Two Phase), which provides a modeling solution for flows such as transitional slug, churn, and annular. In addition to a primary continuous phase and one or more polydisperse secondary phases, GENTOP includes an additional phase that can behave either as continuous or dispersed depending on phase volume fraction and critical bubble diameter.

Industrial applications typically involve geometrical features of very different characteristic length scales. Interface-tracking techniques require very fine mesh near the phase interface, making it computationally expensive for large domains where small geometric features are present. The Lagrangian approach is typically used in such cases. Still, it requires input from experimental or numerical correlations and therefore is not predictive if initial flow structures are paramount for subsequent flow distribution. ANSYS Fluent has comprehensive multiphase model transition capabilities, which allow for dynamic switching between interface-tracking, surface models, and discrete-phase approaches. Together with adaptive mesh refinement, these tools allow for a drastic reduction of computational effort. It is possible to carry out parametric analyses faster or to use more sophisticated models that consider further physical phenomena.