Capturing the transient characteristics of thermally varying particle suspensions

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ABSTRACT

Particle suspensions are of importance in a range of science and engineering disciplines. Notable examples include blood flow in biological systems and the hydraulic fracturing treatments used in the oil and gas industry. In particular, suspensions used for industrial processes may be subject to significant variations in temperature. Such changes can strongly influence the physical properties of the suspension and should be taken into account when modelling these situations numerically.

The viscosity of the fluid phase is the suspension property most significantly impacted by local changes in temperature. However, this thermal impact is often ignored in existing modelling frameworks where material properties are held constant at those found at an appropriate reference temperature [1]. Furthermore, computing physically realistic temperature fields during particle collisions is a consideration that is often overly simplified through the implementation of fixed temperature boundary conditions on the solid phase. This is still a challenging problem to resolve even when more complicated boundary conditions are taken into account [2].

The localised interpretation of both temperature and viscosity within dual-population thermal lattice Boltzmann methods (TLBM) provides a suitable numerical framework for the efficient resolution of these issues. A number of TLBM strategies for modelling the impacts of changing fluid viscosity due to temperature variations will be discussed by this paper. Their implementations in the context of modelling transient particle suspensions will be presented and compared to situations where the viscosity has been held constant.

REFERENCES

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