A computational model for predicting the fluid motion induced by Brownian motions of suspended nanoparticles

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Nanoparticles, when suspended in a base liquid have been reported to enhance heat transfer properties. This suggests a potential in industrial applications. However, the extent of reported enhancements were inconsistent. The underlying principal that leads to the improvements is not clearly understood, albeit the interactions between the particles and fluid which is likely to be the main contributor to the observed phenomena. Further research efforts are needed in this area as the previously proposed theories were inconclusive or even contradicting.

In this study, a novel approach of using computational analytical code is being developed for studying the velocity field in the base fluid induced by the suspended nanoparticles. The Langevin equation was used to evaluate the randomly moving nanoparticles with unconfined Brownian motions. The induced velocity field in the vicinity fluid is determined by solving the governing hydrodynamic equations, assuming no interaction between particles. The criterion of various numerical parameters such as time step size, computational domain definition will be discussed. To reduce the computational cost, the motion of a sample of Brownian particles is traced upon and recorded throughout the calculation, for which a statistical representation of the induced fluid field can then be obtained. The effects of various parameters on the induced fluid field will also be examined and discussed.