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# 悬浮颗粒运动的格子Boltzmann数值模拟

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摘要　将固体颗粒的牛顿力学和格子Boltzmann方法相结合，研究不规则形状悬浮颗粒在流场中的运动．通过受力分析，精确求得其所受合力、合力矩、合力作用中心等．提出了跟随颗粒运动的动网格计算域技术和模拟悬浮颗粒转动运动的局部数组方法及 Euler--Lagrange两套坐标技术．通过对椭圆颗粒运动的数值模拟和对照他人对矩形颗粒的研究，分析了其复杂运动规律，并提供了合理的物理解释．结果表明：运用格子Boltzmann方法和上述特殊技术可以得到与有限元方法相同的模拟精度，且具有计算速度快、对复杂形状边界处理方便灵活、程序简单及特别适合大规模并行计算等优点.

关键词　格子Boltzmann方法,悬浮颗粒运动,动网格,Navier-Stokes方程,并行计算

分类号

# Numerical simulations of suspension motion of irregular shaped particles via the lattice Boltzmann method

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**Abstract**

In this study, we combine the Newtonian mechanics with lattice Boltzmann method(LBM) to simulate the motion of irregular shaped particle suspensions. A moving boundary method to follow the motion of moving particles is used, which can not only trace the motion of particles for a long time, but also increase the speed of computation and decrease the usage of computer memory. We also analyze in detail of the forces acted on the elliptical and irregular particle suspensions. In the study, with the comparison of our results of the motion of elliptical particles with others results of the motion of long square particles, reasonable physical explanations of the complex phenomena are found, which can be used as a guide to understand the motion of particle suspensions with more general irregular shapes. It is shown that the lattice Boltzmann method is as accurate as the finite element method in the simulation of motion of particle suspensions and has a lot of advantages, such as fast and can handle complex boundaries easily. The code of LBM is much shorter than other CFD methods and is particularly suitable for large scale parallel computation.

**Key words** lattice Boltzmann method　motion of particle suspensions　moving mesh　Navier-Stokes equations　parallel computation

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