Yong Kweon Suh et al., J Aeronaut Aerospace Eng 2015, 4:2
http://dx.doi.org/10.4172/2168-9792.C1.010

OMICS International
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3rd International Conference and Exhibition on
Mechanical & Aerospace Engineering
October 05-07, 2015 San Francisco, USA

Use of lattice Boltzmann method to simulate interaction between fluid flow and particle motion in small scales

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Numerical simulation of interaction between fluid flow and particle motion demands sophisticated algorithms due to the motion of particles and difficulty in creating the grid system. We developed, during past decades, numerical solution methods to tackle this problem and applied the methods to several branches of engineering applications of small scales. The method is based on the Lattice Boltzmann Method (LBM). In this presentation, we demonstrate three kinds of numerical solutions provided by the methods. First, we developed the simulation code for the problem of translocation of a biopolymer through a nano–pore driven by an external electric field. A theoretical formula is also used to calculate the net electrophoretic force acting on the part of the polymer residing inside the pore. Next, we simulated the motion of microscopic artificial swimmer. The swimmer consists of an artificial filament composed of super–paramagnetic beads connected by elastic linkers and an externally oscillating magnetic field is used to actuate the filament, and we have found that there is an optimum sperm number at which the filament swims with maximum velocity. Then, we computed the fluid flow generated inside a micro -channel by an array of beating elastic cilia. We have found that there exists a maximum flow rate at an optimum sperm number. We also simulated the motion of particles caused by fluid flow of cilia actuation.

Biography

Yong Kweon Suh has completed his PhD from State University of New York at Buffalo, USA and joined the Faculty of the Department of Mechanical Engineering, Dong-A University in 1986. His current interests include numerical simulation of fluid-particle interaction and electro-hydrodynamic flows.

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