FM16L_10603

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

The Collective Dynamics of Self-Propelled Particles

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Self-propelled particles, such as spermatozoa, bacteria and other microorganisms, exhibit several intriguing features in the collective dynamics, such as the spontaneous formation of spatio-temporal patterns, convection cells etc. In this study, we propose a method that can be used for the dynamic simulation of a collection of self-propelled particles. In our descritpion, each particle is treated as a rigid sphere with a force dipole of constant magnitude. In isolation, it would move at constant velocity set by the magnitude and direction of the force dipole. When it coexists many such particles, its hydrodynamic interaction with other particles rotates it and therefore change its direction of motion, and also induces an additional stresslet on it. The velocity distribution differs significantly from the Guassian, and the collective motion of the particles is diffusive at long time.

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