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STOKESIAN-DYNAMICS SIMULATION OF A SUSPENSION OF SWIMMING MICRO-ORGANISMS

***Takuji Ishikawa[1], J. T. Locsei[2], T. J. Pedley[2] and Takami Yamaguchi[1]**

[1] Dept. Bioeng. Robotics, Tohoku University
6-6-01, Aoba, Aoba-ku, Sendai 980-8579, Japan
E-mail : ishikawa@pfsl.mech.tohoku.ac.jp

[2] DAMTP, University of Cambridge
CMS, Wilberforce Road, Cambridge
CB3 0WA, UK

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ABSTRACT

In this study, we introduce our recent researches on a suspension of swimming micro-organisms. A swimming micro-organism is modelled as a squirming sphere with prescribed tangential surface velocity, referred to as a squirmer. The centre of mass of the sphere may be displaced from the geometric centre, and the effects of inertia and Brownian motion are neglected. The well known Stokesian-dynamics method is modified in order to simulate squirmer motions in a concentrated suspension. The movement of 216 identical squirmers in a concentrated suspension is simulated in a cubic domain with periodic boundary conditions.

The rheological and diffusive properties of a suspension of squirmers are discussed. We show that a suspension of bottom-heavy squirmers has strong non-Newtonian properties [1,2], and that the spreading of squirmers is correctly described as a diffusive process after a sufficiently long time, even though all the movements of the squirmers are deterministically calculated[3]. We also discuss microstructures in a concentrated suspension of squirmers. The results show that; (a) a weak aggregation of cells appears as a result of the hydrodynamic interaction between cells, (b) the cells generate collective motions by the hydrodynamic interaction between themselves, and (c) the collective motions occur randomly in time and in space when the hydrodynamic interaction is stong, whereas ordered collective motions appear when the hydrodynamic interaction is weak. These tendencies show good qualitative agreement with previous experiments.

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