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Numerical simulation of a rotating elastic rod in a viscous fluid using the immersed boundary method RANJITH MANIYERI, YONG KWEON SUH, SANGMO KANG, Dong-A University, South Korea, MINJUN KIM, Drexel University, USA — Immersed boundary method has proved its efficacy in handling complex fluid structure interaction problems in the field of biological fluid dynamics. Inspired by the bacterial propulsion, we are interested to study the interaction of a rotating elastic cylindrical rod in a viscous fluid, where the flow is induced by the rotation of the rod. We developed a three dimensional computational model based on the immersed boundary method (IBM) in which Eulerian variables are used for the fluid flow and Lagrangian variables are used for the elastic rod motion. The Navier-Stokes equations governing the fluid flow are solved based on finite volume method on a staggered Cartesian grid system. The elastic rod is modeled by a number of circular rings with immersed boundary points on each ring. The motor part is modeled by a single circular ring at the base. We simulated for two cases- a straight and slightly bent rod and for an inclined rod. We found that for low rotational frequencies of the motor, the elastic rod undergoes simple axial rotation known as twirling motion and for high rotational frequencies it undergoes whirling motion with a discontinuous shape transition from straight to helical shape resulting into overwhirling. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education, Science and Technology (2010-0147).

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