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**Three-dimensional simulation of jellyfish by the penalty immersed boundary method** SUNG GOON PARK, CHENG BONG CHANG, HYUNG JIN SUNG, Korea Advanced Institute of Science and Technology, FLOW CONTROL LABORATORY TEAM — The interaction between the motion of a three-dimensional jellyfish and the surrounding fluid was numerically simulated by the penalty immersed boundary method (pIBM). The effects of the vortex formation and the elastic properties on the kinematics of swimming jellyfish were examined. In order to simulate the incompressible fluid motion, the fractional step method was adopted on the Eulerian domain, while the subdivision finite element method was used to describe the solid motion on the Lagrangian domain. Coupling of the fluid motion and the jellyfish motion was realized in the framework of the pIBM. Our results suggest that the starting and stopping vortices, which are respectively induced from a power stroke and a recovery stroke, were formed in the wake of the swimming jellyfish. These two types of vortex interacted with each other, which made the size of vortex larger and caused the augmentation of thrust. Swimming performance of the jellyfish also depended on the elastic properties such as the tension and bending rigidity. It was found that the center velocity of the jellyfish increases with increasing the tension rigidity.

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