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A self-propelled flexible plate with a keel-like structure[1] JONGMIN YANG, HYUNG JIN SUNG, KAIST — The caudal keels, a pair of lateral keel-like structures along the caudal peduncle, are a remarkable specialization in tunas. Although various hypotheses about the function of caudal keels have been proposed, our understanding of their underlying hydrodynamic mechanism is still limited. The immersed boundary method is used to explore the self-propelled flexible plate with the keel-like structure. Vortical structures and pressure distributions are analyzed here to determine the mechanisms of thunniform propulsion. By comparing models with and without keels, caudal keels generate streamwise vortices that result in negative pressure and enhance the average cruising speed and thrust. The propulsion mechanisms are analyzed in detail in terms of phase of stroke. The average cruising speed and the swimming efficiency are increased by more than 3.6% and 3.8% with keels, respectively. The vortical structures are visualized to characterize the mechanism with keels qualitatively. A systematic study of the effects of variations in the keel shape vertically and horizontally is also presented.

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