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The correlation between 2D-3D wake transition and propulsive efficiency of a flapping foil[1] LIPING SUN, JIAN DENG, XUEMING SHAO, Department of Mechanics, Zhejiang University, Hangzhou 310027, People's Republic of China — We study numerically the propulsive wakes produced by a flapping foil. As a major contribution of this report, we find an interesting coincidence that the efficiency maximum agrees well with the 2D-3D transition boundary. Although lack of direct 3D simulations, it is reasonable to conjecture that the propulsive efficiency increases with Strouhal number until the wake transits from a 2D state to a 3D state. By comparing between the pure pitching motion and the pure heaving motion, we find that the 2D-3D transition occurs earlier for the pure heaving foil than that of the pure pitching foil. Consequently, the efficiency for the pure heaving foil peaks more closely to the wake deflection boundary than that of the pure pitching foil. Furthermore, since we have drawn the maps on the same parametric space with the same Reynolds number, it is possible to make a direct comparison in the propulsive efficiency between a pure pitching foil and a pure heaving foil. We note that the maximum efficiency for a pure pitching foil is 15.6%, and that of a pure heaving foil is 17%, indicating that the pure heaving foil has a slightly better propulsive performance than that of the pure pitching foil for the currently studied Reynolds number of $Re = 1700$.

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