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Thrust generated by a flapping flexible plate FLORINE PARAZ, CHRISTOPHE ELOY, LIONEL SCHOUVEILER, Aix Marseille Université, CNRS, Centrale Marseille, IRPHE, Marseille, France — In order to a gain better insight into the physics of swimming with a flexible caudal fin, we have performed experiments with a rectangular elastic plate immersed in a water flow. The plate leading edge is forced into harmonic motion, while its trailing edge responds passively to this actuation. A resonance has been evidenced experimentally, pointing out a strong coupling between the natural frequencies of the structure and the forcing frequencies. In this experiment, the forcing amplitude plays a non-trivial role, emphasizing the role of non-linearities in this problem. To better understand the origin of these non-linearities, a weakly non-linear model has been developed. We assumed a quasi two-dimensional plate of zero thickness immersed in a potential flow and subject to a resistive drag-like force. The plate deflection has then been decomposed into a forcing heaving mode and natural flexural modes. This modeling approach allowed us to predict the response to the heave forcing as a function of its amplitude and frequency. The frequencies of the resonances, as well as the deflection enveloppes, are well captured by this model. The performance of the system, measured through the generated thrust, is also well predicted by this model.

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