Engineering of a Bio-Inspired Tiltable Oscillating Fin Submersible Thruster

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Marine vertebrates have declined in abundance in the last four decades by an average of 22%. To observe marine organisms effectively, a waterborne propulsion system with minimal environmental disturbance and high maneuverability is required. The oscillating fin presents a novel low-disturbance thruster, and the seahorse dorsal fin, capable of oscillation and inclination, possesses ingeniously structured physiology, as observed. This study aims to analyze the seahorse dorsal fin's dynamic effects and design a flexible and stable thruster for underwater detection. Through CFD analysis, fin inclination is hypothesized to control the net force direction. A test platform was constructed to examine the influences of wave features and inclination angle on thrust in both vertical and horizontal directions. Additionally, discrete fin surfaces were utilized to eliminate force interference. Force testing and snapshots indicate that wave velocity positively influences net force magnitude. Fin inclination allows for control over force orientation, within an angle range of 0 to 81 degrees, and different fin pivot positions affect the turning ability of the robot. Iterative construction led to the development of three prototypes. These prototypes incorporate a linkage mechanism for controlling fin ray inclination, transitioning from a scheme involving multiple servo motors to an eccentric shaft structure. In conclusion, the inclination of the fin enables control over thrust magnitude and orientation, providing greater flexibility and maneuverability. The novel tiltable underwater thruster possesses the advantages of minimal disturbance to the surrounding environment, high flexibility, and stability to achieve observation of marine organisms.

Awards Won:

Third Award of $1,000