

Biomimetic oscillating propulsion mechanism for a robofish using embedded control system

S. B. Pranesh, V. B. N. Jyothi*, E. Chandrasekaran, N. Vedachalam, S. Ramesh and G. A. Ramadass

National Institute of Ocean Technology, Ministry of Earth Sciences, Chennai 600 100, India.

The present study depicts the tail fin design, realisation, and propulsion performance of the biomimetic robofish prototype utilising the carangiform motion for efficient two-dimensional (2D) propulsion. Lighthill's 2D waving plate theory and MATLAB simulations are used to optimise the thrust by varying link and joint configurations. The two-link design achieves a speed of one knot in forward and reverse using a 12 V, 7 Ah battery and servo motor with pulse-width modulation. The robofish is onboard programmed with a timed sequence actuation for forward and downward manoeuvring. An experimental validation in the test tank confirms its performance, showing its potential for advancing bio-inspired underwater propulsion systems.

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tion force. Hydrodynamic analysis⁷⁻⁹ aims to optimise the shape of the body and fins to minimise drag and maximise water displacement lateral to the body.

Innovating underwater vehicles is influenced by the morphology of swimmers. Underwater vehicles that mimic these swimmers, such as manta rays, will be efficient and highly maneuverable¹⁰. Using Lighthill's wave theory, carangiform swimming generates thrust while thunniform swimming generates lift with a stiff body and flapping caudal fin, reducing water resistance while maximising propulsion efficiency. The motion of a bio-mimetic robofish was studied using deep reinforcement learning to maximise propulsion efficiency and minimise energy use¹¹ in the propulsion system.

Tail fin propulsion is a bio-inspired source of propulsion and manoeuvring in underwater vehicles, offering higher efficiency, less power consumption, and better manoeuvrability than brushless DC motors. The dimensions of the tail fin and joints have been varied in MATLAB sim-