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A Short Description of Flow Mechanism of a Swimming Fish

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INTRODUCTION

Fish is nature's archetypal swimmer. Past study of interspecific variation in the swimming speed of fishes has focused on internal physiological mechanisms that may limit the ability of locomotors muscle to generate power. In this paper, we approach the question of why some fishes are able to swim faster than others from a hydrodynamic perspective, using the technique of digital particle image velocimetry. It is used to measure the fluid velocity and estimate the wake momentum and mechanical forces due to locomotion. Animals generate fluid-dynamic forces by flapping flexible supplements such as wings or fins during swimming or flying.

The force produced by motion of these flexible structures can be resolved into vertical force which support the weight of the animal and horizontal force which provide thrust for forward motion. The aerial and aquatic animals with wing-like appendages can generate these vertical and horizontal forces by propelling in forward direction. Aerial animals in order to support their weight, generates more net upward force than aquatic animals. Aquatic animals often generate vertical forces, which cancel over single stroke. In spite such differences, the principle governing fluid flow around a flapping appendage remain the same. The main focus is to understand the motion and shape of an appendage, determination of the timing and magnitude of forces derived from these fluid stress.

FACTORS RESPONSIBLE FOR PERFORMANCE OF A SWIMMING FISH

Leah Mendelson and Alexandra H. Techet investigated the structure and strength of the wake in three dimensions to determine how hydrodynamic force varies in two species that differ markedly in maximum swimming speed. The fish exhibits forward swimming and turning behaviors at speeds between 0.9-1.5 body lengths/second. Results show clearly isolated and linked vortex rings in the wake structure, the thrust jet from the visual hull reconstruction of the fish body.

Fish have evolved to live in challenging environments due to the relationship between form and function. It provides base for creation of biomimetic swimming robots. The design of vehicles, developed by Barrett et al. (1999), Fish et al. (2003), and Epps et al. (2009), can be expressively amended with detailed quantitative analysis of the momentum transfer between the fish and the fluid during swimming. The behaviour of fish during swimming is integrally three- dimensional (3D), with diverse fin and body motion and fin-wake interactions. The complex nature of these behaviors proposes the 3D rendering, with sufficient spatial and temporal resolution, necessary for simultaneous capture of relevant kinematics and hydrodynamics to enable the propulsive performance.

CONCLUSION

The increase in wake momentum and proper orientation of momentum in a given direction is more advantageous for thrust than lateral force. At low speeds, the large lateral forces exhibited by a swimming fish may be necessary for stability. Secondly, it is proposed that a potential hydrodynamic trade-off between speed and maneuverability arising as a geometric consequence of the orientation of vortex rings shed by the pectoral fins.

Early works on fish swimming hydrodynamics used qualitative shadowgraph technique that suggested a series of linked 3D vortex rings in the wake of a progressively swimming fish during both in push and coast swimming mode. For the purpose of quantifying the wake hydrodynamics behind the swimming fish, researcher evolved a non-invasive method measurements such a particle image velocimetry.

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