Dolphin-kick swimming maximizes water-flow utilization with increasing speed, researchers find

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Researchers from University of Tsukuba investigated the propulsion mechanism by visualizing water flow around a swimmer during underwater dolphin-kick swimming in a water channel via particle image velocimetry. Their findings revealed that swimmers can utilize water flow and vortexes more effectively as their speed increases. The research is published in the *Journal of Biomechanics*.

The swimming motion imparts momentum to water, a fluid, thereby generating a propulsive force. Thus, we can understand the propulsion mechanism by examining the water flow generated by a swimmer's motion. However, observing colorless, transparent water with the naked eye or a camera is challenging.

To address this issue, researchers employed particle image velocimetry, a technique utilized in fluid dynamics, to visualize water-flow patterns. They investigated how water flow changes as swimmers change their speed while executing the dolphin-kick swimming technique. This investigation was conducted in an experimental circulating water channel (a pool with flowing water).

The results revealed that the water-flow velocity increased with increasing swimming speed during the underwater dolphin-kick lower-limb action, generating a strong vortex during the kicking action. This phenomenon possibly contributes to the increased propulsive force. Additionally, recycling of the flow generated during the downward-kick phase was observed during the transition to the upward-kick phase, with the effect becoming more pronounced as the swimming speed increased.

This study marks the first observation of water-flow changes during dolphin-kick swimming at varying speeds. The study is expected to advance research on water flow, a critical topic in swimming research. It offers scientific evidence for instructors to adopt kick-swimming techniques.

More information: Yusaku Nakazono et al, Impact of variations in swimming velocity on wake flow dynamics in human underwater undulatory swimming, *Journal of Biomechanics* (2024). DOI: 10.1016/j.jbiomech.2024.112020

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