

## A Laboratory Study into the Effects of Surface Waves on Freestyle Swimming

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**Abstract :** Open water swimming has been an Olympic sport since 2008 and is growing in popularity world-wide as a low impact form of exercise. Unlike pool swimming, open water swimmers experience a range of different environmental conditions, including surface waves, variable water temperature, aquatic life, and ocean currents. This presentation will describe experimental research to investigate how freestyle swimming behaviour and performance is influenced by surface waves. A group of 12 swimmers were instructed to swim freestyle in the 54 m long wave flume located at The University of Western Australia's Coastal and Offshore Engineering Laboratory. A variety of different regular waves were simulated, varying in height (up to 0.3 m), period (1.25 - 4s), and direction (with or against the swimmer). Swimmer's velocity and acceleration, respectively, were determined from video recording and inertial sensors attached to five different parts of the swimmer's body. The results illustrate how the swimmers stroke rate and the wave encounter frequency influence their forward speed and how particular wave conditions can benefit or hinder performance. Comparisons to simplified mathematical models provide insight into several aspects of performance, including: (i) how much faster swimmers can travel when swimming with as opposed to against the waves, and (ii) why swimmers of lesser ability are expected to be affected proportionally more by waves than elite swimmers. These findings have implications across the spectrum from elite to 'weekend' swimmers, including how they are coached and their ability to win (or just successfully complete) iconic open water events such as the Rottneest Channel Swim held annually in Western Australia.

**Keywords :** open water, surface waves, wave height/length, wave flume, stroke rate

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