

3D TRAJECTORY ANALYSIS OF THE FRONT-CRAWL STROKE: A PILOT STUDY

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Vol 20 – Supplement ■■ 2026 ■■ Brazilian Journal of Motor Behavior ■■ ISSN 2446-4902

The use of programming tools in swimming biomechanical analysis has become increasingly relevant due to the need for accessible cost-effective, and accurate evaluation methods. These tools allow coaches, swimmers, and technical staff to perform detailed underwater analyses without relying on expensive or complex systems. Therefore, the aim of this study was to develop a methodological protocol for analyzing front-crawl biomechanics using programming tools and specialized software such as Kwon3D and MATLAB. Three female student swimmers from the Faculty of Sport Sciences at the University of Granada (22±1 years, 1.66±0.03m of height, 61.17±3.21kg of body mass, 31.5±1.1s 50m front-crawl time) voluntarily participated in a resisted swimming test. Each swimmer completed 20m trials under four loading conditions (0, 1, 3, and 5kg) applied using the 1080 Sprint 2. Data were collected in a 5x2m underwater recording area starting at the 10m line. Four GoPro HERO9 cameras were used for motion capture. A right wrist mounted tracker was attached to each participant to facilitate motion tracking. Movement data were processed using Kwon3D software to extract 3D coordinates (X, Y, and Z axes). Subsequently, a custom MATLAB script was developed to analyze the data, compute average trajectory curves for each axis, and compare the unloaded condition with the resisted conditions. As a result, the average trajectories were calculated across the three swimmers for each axis and load condition. A margin of ±0.05% of the maximum and minimum values was registered along the trajectories. The developed protocol through the integration of programming tools enabled a systematic analysis of front-crawl biomechanics using Kwon3D and MATLAB, facilitating efficient data processing and, contributing to a better understanding of the kinematic changes that occur during semi-tethered swimming. Future studies should include larger sample sizes and compare a wider range of loading conditions to further validate and expand these findings.

Key-words: Swimming, Biomechanics, Design, Analysis, Resisted