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Path Linearity of Elite Swimmers in a 400 m Front Crawl Competition

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ABSTRACT

In the frontal crawl, the propulsive action of the limbs causes lateral fluctuations from the straight path, which can be theoretically seen as the best time saving path of the race. The purpose of the present work was to analyze the head trajectory of 10 elite athletes, during a competition of 400 m front crawl, in order to give information regarding the path linearity of elite swimmers. The kinematic analysis of the head trajectories was performed by means of stereo-photogrammetry. Results showed that the forward speed and lateral fluctuations speed are linearly related. Multiple regression analysis of discrete Fourier transformation allowed to distinguish 3 spectral windows identifying 3 specific features: strokes (0.7-5 Hz), breathings (0.4-0.7 Hz), and voluntary adjustments (0-0.4 Hz), which contributed to the energy wasting for 55%, 10%, and 35%, respectively. Both elite swimmers race speed and speed wastage increase while progressing from the 1st to the 8th length during a 400 m front crawl official competition. The main sources of the lateral fluctuations that lead to the increasing speed wastage could be significantly attributed to strokes and voluntary adjustments, while breathings contribution did not reach statistical significance. In conclusion, both strokes and voluntary adjustments are the main energy consuming events that affect path linearity.

Key words: Drift, lateral fluctuations, video analysis, performance assessment, swimming

Key Points

- The lateral fluctuations (LF) represent indexes of elite performance swimmers during 400 m competitions.
- The voluntary adjustments needed to go back to the ideal trajectory are more energy consuming than the movements of the swimmer for maintaining the path linearity.
- The diverge from the ideal swimming trajectory during a high level competition explain about 14.7% of the variations of the average forward velocity during the race.