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Better coaching the elite swimmer with the applied use of the optimal individual stroke rate parameters.

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Abstract

A good number of mathematical relations found between the obtained speeds on clean swimming but equally on non-swim areas (starts, turns, underwater part) can be a source of potential help to the individual swimmers if they can be computed. Looking to take the spontaneous frequency of swimming to take advantage of it in an applied way of better learning (for the swimmer) and better coaching has been a method we developed from 1991 in the national sport institute of Paris (INSEP) since it appeared to be the most effective in terms of swim economy. The stroke rate/velocity relationship is very interesting since its mastering has a lot of consequences on energy cost, delay of fatigue and better learning of the best stroke at any moment in training sessions or competitions. The stroke rate/velocity test is incremental and carried though the observation of 15 meters of clean swimming where 3 full cycles are measured considering the time and the spontaneous stroke rate of the swimmer, during 8 progressive steps. These starting points guided the development of several types of software beneficial to swimming training including NATAVIT (1995-2000) and AQUACYCLE (since 2000) but equally a concept of measurement automated in training (CHRONOCYCLE) and at last a federal video-electronic system which is used in competition by the French Swimming Federation).

Key Words
Modelling, swimming, cadence, velocity, stroke length, feed back

Introduction

Looking to take the spontaneous frequency of activity to take advantage of it in an applied way of better learning (for the swimmer) and better teaching (for the coach) has been a mission since 1991[1, 2]. In swimming, the spontaneous stroke rate/velocity was at first an indicator then became a systemized test from 1992 [3, 4]. It is used in many countries, notably in swimming to determine if the rate and by result the distance per stroke, also called stroke length, used by a swimmer at a given moment in his swim (in training or competition) is the most effective in terms of economy as well as in other sports [5, 6, 7, 8, 9]. This starting points guided the development of several types of software beneficial to swimming training including NATAVIT [10] (1995-2000) and AQUACYCLE (since 2000) but equally a concept of measurement automated in training (CHRONOCYCLE) and at last a federal video-electronic system which is used in competition by the French Swimming Federation. In France and at INSEP in particular, the choice of a kinetic study of cyclic parameters evolving within useful swim velocities was at the origin of the belief in the relation between stroke rate and velocity. This was confirmed through the development of standards for this test and through the use of tools. The applied usage in training of these tests was carried out through the use of individual test results established using tables (Microsoft Excel), then on programmable machines (from 1992 to 1996), leading the French Swimming Federation (FFN) to ask INSEP to develop a specific software NATAVIT. This software allowed from data obtained in tests at the National Training Centre, the computerized mastering of the accurate individual velocities of swims, with indications for the best cyclic, physiological and technical methods.

Methods of evaluation and follow up in training

The stroke rate/velocity test is incremental and carried though the observation of 15 meters of pure or cleans swimming where 3 full cycles are measured considering the time and the spontaneous stroke rate of the swimmer, during 8 progressive steps. It allows for every swimmer to be given theoretical cyclic parameters vs. observed ones during future sessions. Theoretical Stroke Length (TSL) vs. Observed Stroke Length (OSL), Theoretical Stroke Rates vs. Observed Stroke Rates (OSR) and even Theoretical Stroke index (TSI) vs. Observed Stroke index (OSI), all of them being good factors to take into account in terms of swimming economy during the observations of training sessions and races. The linear adjustments of the relationship of stroke rate velocity and Distance per stroke velocity all the more correlated since the level of expertise of the swimmers is high [2]. It is normal for the physical to be linked to drag as the distance per stroke diminishes in a manner inversely proportional to velocity according to a linear mathematic relationship.

Discussion

Many elite swimmers seem insufficiently educated on this approach [2]. The observation of swimmers in competition [11] indicates unnecessarily high stroke rates in comparison with their individual demonstrated ideal economy of swims for the velocity given. The confusion between « velocity and turn over » is all the more natural under the stress of competition. This is the reason it must be checked and practiced in training and at certain competitions. From exchanges with T.M. Absaliamov, the long time expert in charge of the study of the Soviet then Russian swimmers, we reinforced the fact that the pace regularity and stroke rates of Salnikov or of Sadovy, the technical management of race of Popov, had been obtained by practice and were the fruit of very elaborated feed back. In France, the number of repetitions at race velocity, while doing the report on the cyclic parameters is more and more used with the swimmers. Work at sub-maximal speed deserves equally to be given to swimmers with a reference to cyclic objectives, for example a number of arms strokes by length according to the speed of the swimmer.

Conclusion

Our evaluations show that for all the swimmers that get faster at INSEP over several years, the two values of stroke rate and race pace still evolve in the direction of an increase of the distance per stroke and of a decrease of the rate. Nevertheless, only the improvement of performance in times must remain the objective. The increase of the distance per stroke for a velocity of given swims (and therefore the proportional decrease of the rate) is only interesting if the swimmer preserves the same « potential of rate » throughout his career to attain a race pace which always improves in competition. Different methods can help optimize the management of the cyclic fitting parameters to the velocity of the corresponding swims. The example of the relationship between stroke rate and the velocity of swims seems to be the most striking. After determining the equation rate velocity MSR (modelled individual stroke rate), this one can be integrated into software or computer devices (programmable machine, software on computer or PAD) and will use the swimming economy index for the calculation of the ideal cyclic parameters for all the times for all distances and size of pool and of given send-offs. This system offers the chance to do a cyclic and technical example with the swimmer immediately after each series. Recent developments (AQUACYCLE) allow as well the possibility for the swimmer to selfevaluate simply in terms of «arm hits» : checking the clock and counting the arm strokes is enough but essential for better learning. These methods allow the swimmer to refine his mastery of spatial-mental skills, a critical step in his control of the cyclic parameters relating to his velocity of swims. These situations where objective information is given during or immediately after the stop of the exercise are essential for the formation of swimmers. This is particularly useful with the long distance swimmers where the instruction or feedback during the exercise contribute to the learning curve necessary to maintain of the stability of the energy cost [12, 13, 14, and 15]. Constant pace is a strategy that has been proven in terms of swimming economy and most notably in records surpassed; nevertheless, there are often other strategies [16] that prove themselves essential to winning at championship meets where the individual athlete is confronted with the primary objective of being on the podium. Faster start, accelerate at the right moment or know how to « touch them out » must have also been worked in training; but to start out faster does not mean a « breakthrough » in attempting to go for broke; that is taking a strategic risk, calculated in certain cases or by feel in others, with a technique of swimming able to react, in an adapted way to the immediate needs of the swimmer. The mastery of the relationship between stroke rate and velocity allows one to work towards swimming at a constant speed and therefore to a stable rhythm, to adapt with better effectiveness to all likely velocities used by the swimmer. The acquisition of biomechanical indicators by trial and error across the spectrum of velocities allowing the movement in water, with « feedback » in the fastest possible manner on execution is probably a learning curve for the elite swimmer in the years to come.

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