Hydrodynamic quality factor as an objective quantitative characteristic of assessment of swimming technique

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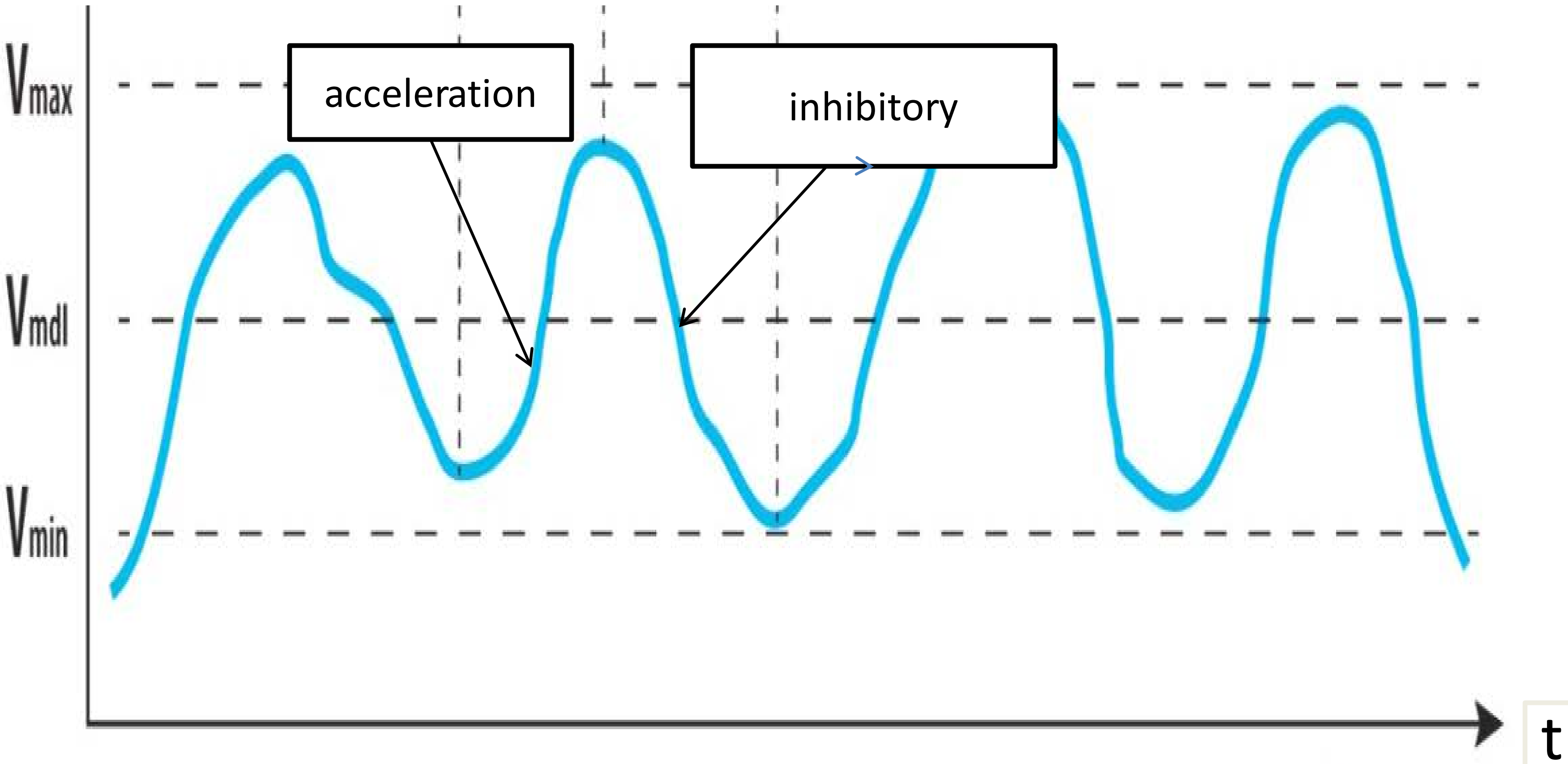
STROKE EFFICIENCY IS **ESTIMATED** AND CONTROLLED IN **REAL TRAINING** AND **COMPETITIVE EXERCISES** USING THE METHODOLOGY **ESTIMATING THE TRAVEL SPEED** OF THE **COMMON CENTER OF MASS OF ATHLETE'S BODY (CCMAB)** OR THE **METHODOLOGY OF EVALUATION OF THE DYNAMICS OF CLOSED CYCLE SPEED**

Closed cycle speed (CCS) of CCMAB is characterized by V_{max}, m/s – maximal values of swimming CCS in one cycle, V_{min}, m/s – minimal value of swimming CCS in one cycle and alternation of acceleration and inhibitory phases, V_{midi} – average value of swimming

The dynamics of CCS of CCMAB in swimming, V_{max} , V_{min} , V_{mdl} maximal, minimal and average values of speed of CCMAB respectively.



It’s known CCS of CCMAB in swimming is changed according to the quasiperiodic law, providing the opportunity to involve some conditions of mathematical apparatus of the vibration theory to estimate stroke efficiency in real movements.

The **energy efficiency of the quasiperiodic process** is estimated by the quality of the oscillating system Q.

Quantitatively the quality Q is equal to the **ratio of energy saved** in the system and the **value of energy lost** in one period of oscillations, multiplied by 2π.

We called the obtained characteristics **"hydrodynamic quality coefficient" (HQC)** or **hydrodynamic quality Q.**

Since energy is definitely related to the squared travel velocity, in our case quality is equal to

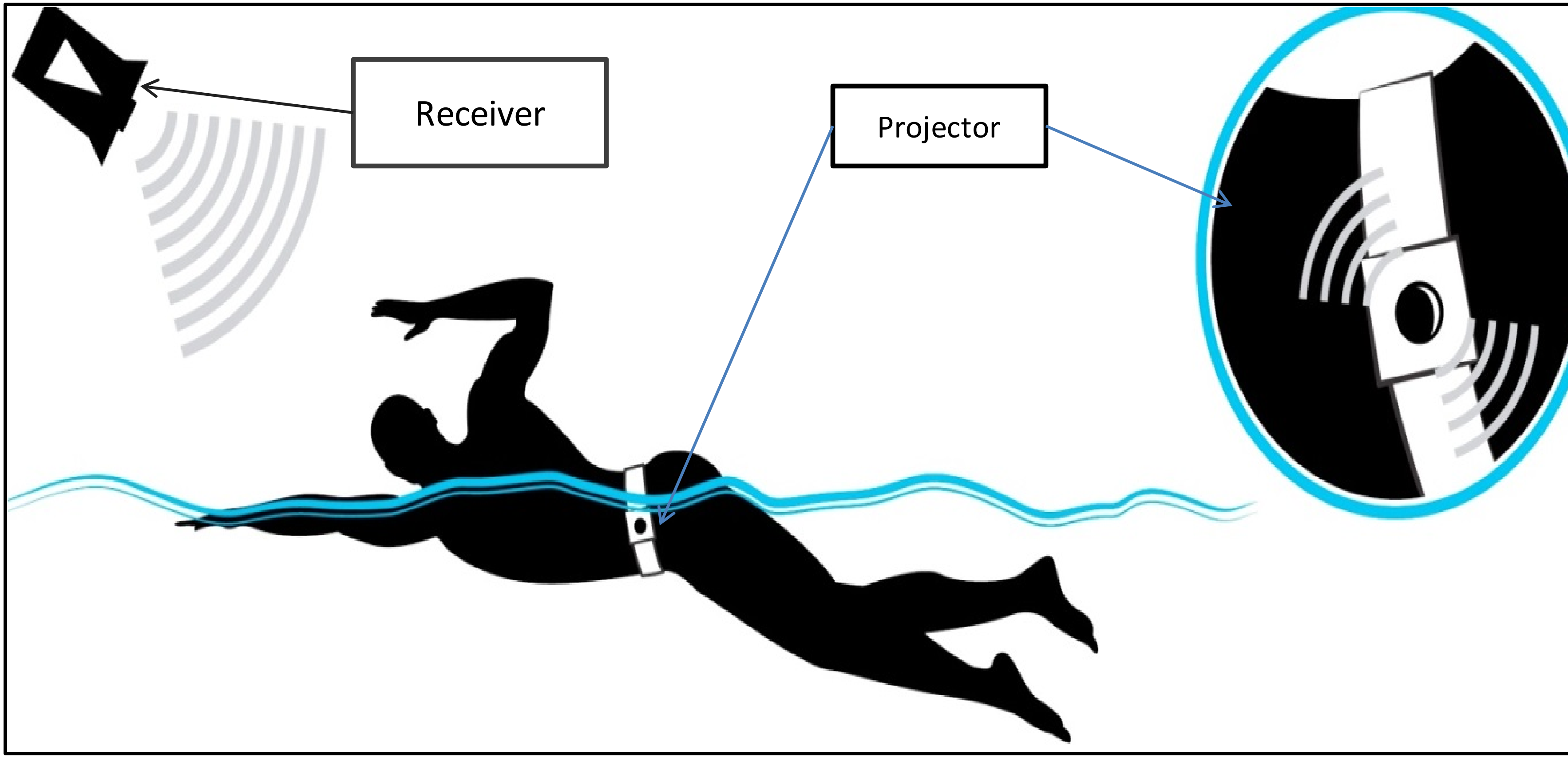
$HQC = Vmax^2/(Vmax^2 – Vmin^2)$

where : V_{max}, m/s - maximum CCS in one swimming cycle;

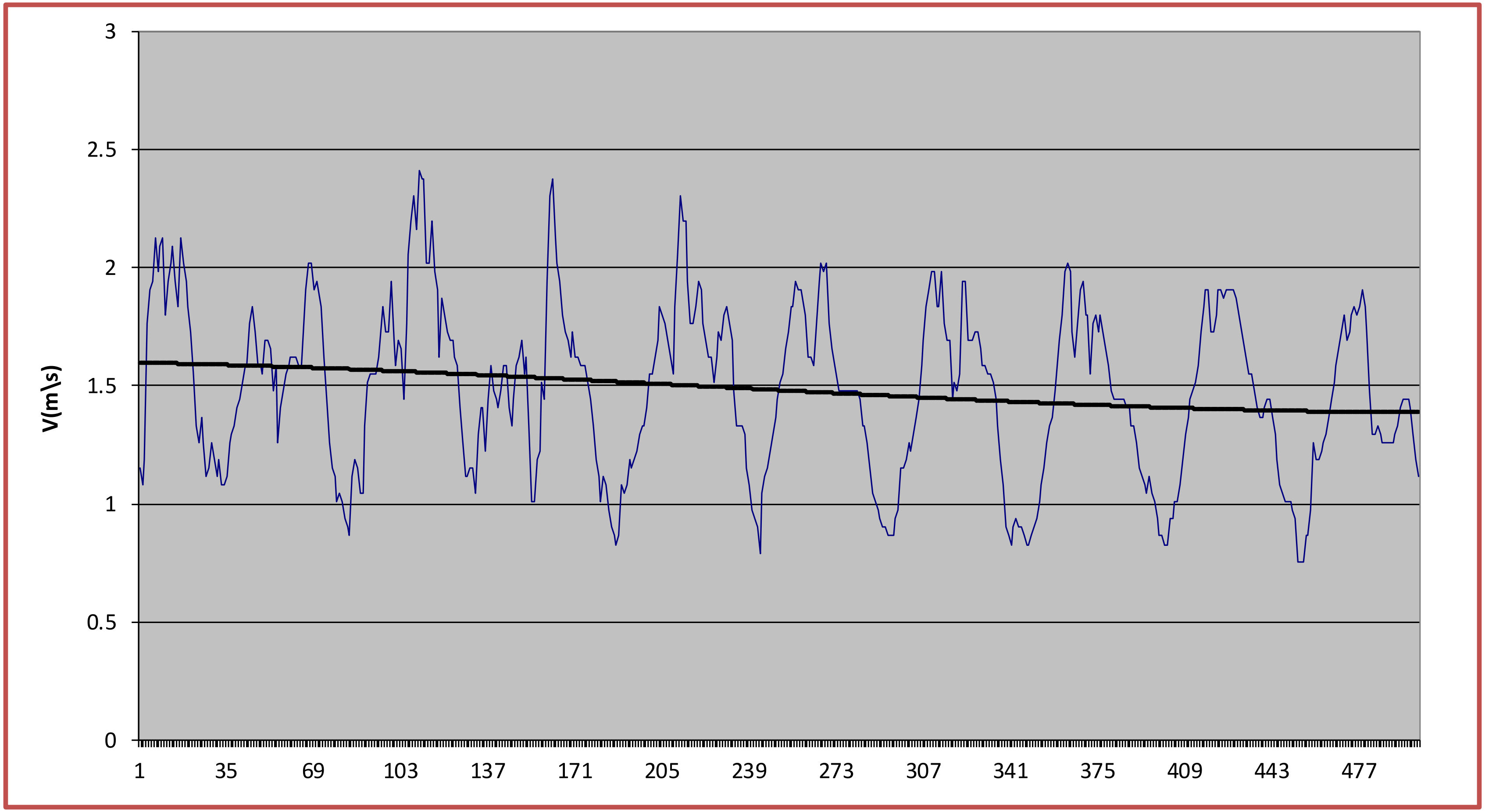
V_{min}, m/s - minimum CCS in one swimming cycle.

We used the method of hydro acoustic speed recording to estimate the dynamics of CCS of CCMAB.

This method measures of CCS of CCMAB using the Doppler’s effect.



Example of the dynamics of CCS of CCMAB at butterfly stroke



HQC indices for different swimming styles for men (n=8)and women (n=7). (X – average value ,σ - standard deviation).

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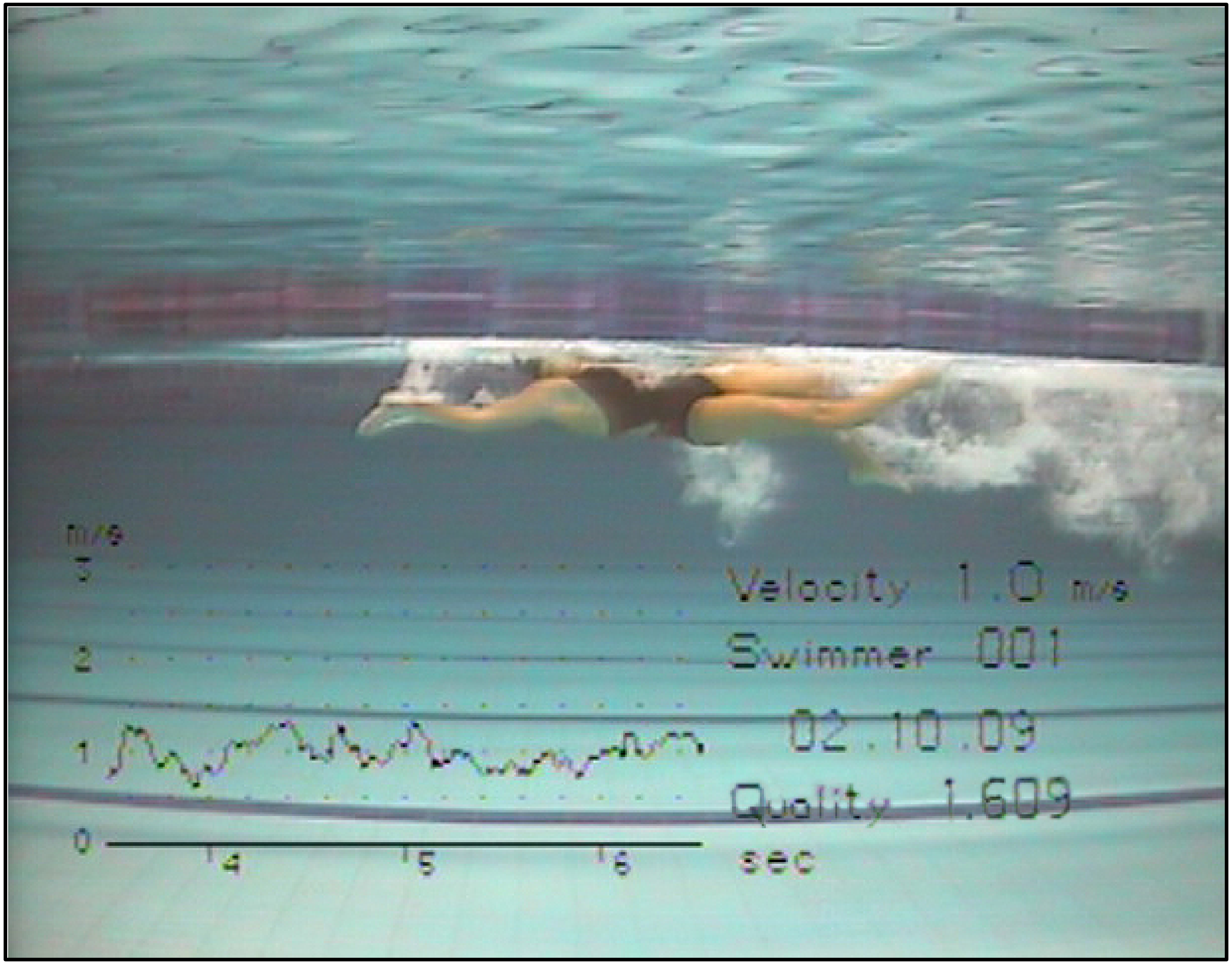
	Vmax,m/s X± σ		Vmin, m/s X± σ		Vavg, m/s X± σ		K	
Swimming style	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Freestyle	**1,88±0,06**	**1,63±0,09**	**1,56±0,06**	**1,37±0,10**	**1,70±0,05**	**1,49±0,09**	**3,3**	**3,54**
Backstroke	**1,68±0,10**	**1,59±0,08**	**1,40±0,11**	**1,35±0,09**	**1,54±0,09**	**1,45±0,08**	**3,45**	**3,86**
Butterfly	**2,01±0,11**	**1,66±0,16**	**1,09±0,14**	**0,94±0,11**	**1,52±0,10**	**1,29±0,12**	**1,45**	**1,51**
Breaststroke	**1,79±0,13**	**1,60±0,16**	**0,86±0,14**	**0,70±0,10**	**1,30±0,07**	**1,16±0,09**	**1,32**	**1,26**


m/s
3
2
1
0
4
5
6
sec
Velocity 1.0 m/s
Swimmer 001
02.10.09
Quality 1.609

Conclusions

1. The methodical approach to the **quantitative assessment of the swimming technique effectiveness** was proposed.

2. The biomechanical characteristic named **“hydrodynamic quality factor” was developed and tested** in different swimming styles.

3 . We have suggested **“hydrodynamic quality factor” can be used** to estimate the level of athletes’ technical skills **in phased and current examinations and when developing model characteristics of the technique** of performance of competitive and training exercises in sports swimming.