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Original Article

Objectification of technical and tactical training of athletes in running target shooting

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Abstract.
There were found contradictions connected with the directions of improving technical and tactical training of athletes in shooting that could be overcome by defining and visualizing the spatial and temporal parameters of the critical phases of the aiming weapon motion (aiming point trajectory) in running target shooting. **The aim of research** was to reveal model characteristics of running target shooting as a direction of objectification of the improvement of technical and tactical training of athletes in running target shooting. **Results**. Model characteristics of shooting at running targets of slow speed are, in particular, the reset of weapons / ready position (S_k = 341 ± 27 ms); the aiming weapon movement (P_p = 4083 ± 102 ms); series of the shot (C_p = 4423 ± 106 ms); reserve phase of the aiming weapon movement (t_r = 577 ± 105 ms); temporal parameters of the paradoxical phase of the target run (at a minimum flying speed of bullets at 50 m t_p = 0,20 s; with a minimum flight speed of bullets at 10 m t_p = 0,10 s); linear parameters of the paradoxical phase of the target run (in shooting 50 meter rifle S_p = 40 cm; in shooting air rifle 10 m S_p = 4 cm). Model characteristics of shooting at running targets of rapid run are, in particular, the reset of weapons / ready position (S_k = 404 ± 59 ms), the aiming weapon movement (P_p = 1407 ± 119 ms); series of the shot (C_p = 1811 ± 125 ms); reserve phase of the aiming weapon movement (t_r = 689 ± 165 ms); temporal parameters of the paradoxical phase of the target run (at a maximum flying speed of bullets at 50 m t_r = 0,12 s; with a maximum flight speed of bullets at 10 m t_r = 0,05 s); linear parameters of the paradoxical phase of the target run (in shooting 50 meter rifle S_p = 80 cm; in shooting air rifle 10 m S_p = 8 cm).
Key words: running targets shooting, technical and tactical training, aiming weapon movement, model characteristics of aiming weapon motion.

Introduction

The growth of rivalry on the world arena in shooting competitions requires a qualitative improvement of technical and tactical skills of athletes in running target shooting. The problems of improvement of the shooting techniques were researched in different works [1; 2; 5; 12]. In particular, there were illustrated positive examples of the use of various pedagogical techniques and means to increase the effectiveness of training and competition activities of shooters in different disciplines. However, the results of such researches did not touch upon the actual issues of the system of training in running target shooting.

In running target shooting in the final phase of the target movement there could be noticed critical parameters of aiming where it is impossible to make the effective shot. It is caused by hitting the bullet into the unfired zone and missing the shot according to the competition rules. In sports practice this happens within training sessions and competitions, even at World Championships. Such an unexpected phenomenon of failure during proper aiming characterizes the critical parameters of aiming the final phase of shot in running target shooting. Moreover, such situation does not correspond to the usual notions of the performing of athlete's technical and tactical actions. However, the amount of published scientific works on shooting at running targets is low [2; 13; 14], and the issue of determining the spatial and temporal parameters of aiming weapon movement (aiming point trajectory) is studied insufficiently.

Thus, the revealed contradictions require professional resolution and illustrate that the problem of definition and visualization of spatial and temporal parameters of the critical phases of the aiming weapon movement in running target shooting is actual. That is why technical and tactical training of athletes in running target shooting should be researched more attentively.

The aim of research was to reveal model characteristics of running target shooting as a direction of objectification of the improvement of technical and tactical training of athletes in running target shooting.

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Material and methods

The following methods were used to solve the main aim of scientific research: theoretical analysis of literature; the method of electronic registration of spatial and temporal parameters of critical phases of the aiming weapon movement in running target shooting; pedagogical experiment; mathematical and statistical methods.

There was used method of visualization of critical phases of the target movement based on the invention patent: 16989 Ukraine, IPC F41J 5/00 "Device for visualization of the critical phase of the aiming weapon movement in shooting at running targets". This enabled to provide instant and accurate determination of spatial and temporal parameters of the aiming weapon movement.

The device for visualizing a paradoxical phase of the aiming weapon movement (aiming point trajectory) in running target shooting is represented by a stationary base, a radiation source set up with a possibility of rotation relative to a fixed base, an electric motor connected to the control unit, a P-shaped frame and a screen with screensavers, pusher, guides, brackets and terminal switches (the screensavers are interconnected by traction).

Specialized departments of shooting and technical sports of Lviv State University of Physical Culture and Physical Education of Khmelnytsky National University have been selected as the basis of experimental work. There were involved the athletes from Ukrainian national team in shooting, among them 5 Masters of sport of international class and 31 Master of Sports of Ukraine. They all participated in the leading international competitions (World and European Championships). In general, for the obtaining objective data, there were registered and processed more than 16 thousand indicators of information.

The organization of the research included three stages for several years. Within the first stage (2015-2016), the scientific literature on the topic of research, protocols of international competitions were analyzed, mathematical transformations of spatial and temporal parameters of critical phases of the aiming weapon movement were made. There was formulated the initial hypothesis that the visualization of the critical phases of the spatial and temporal parameters of the target run should increase the accuracy of the aiming weapon movement. During the second stage (2016-20017) there was held a pedagogical experiment (testing) of athletes in running target shooting. During the third stage (2017-2018) the experimental data were summarized and systematized.

Results

There was explored the nature of the phenomenon of uncontrolled misses during the correct aiming and weapon movement (aiming point trajectory) in running target shooting. In shooting on electronic and paper running targets at 50 m and 10 m the targets move slowly and with high speed in both the left and right directions according to the competition rules. This means that the final phase of the target's run, which is paradoxical, is located from the right, then from the left side of the window of the run, according to the direction of the target movement (Fig. 1).

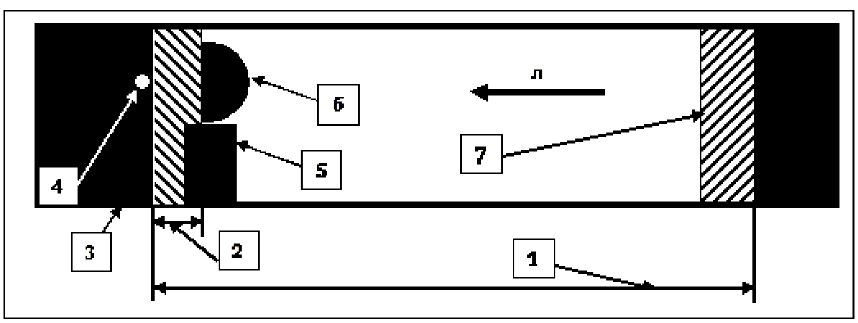

Fig. 1. The scheme of visualization of critical phases of the target run:
1 – width of the window of the target run; 2 – critical phase of left-handed targets run; 3 – unfired zone; 4 – a missing shot (the hit is not counted); 5 – sight scourge; 6 – running target; 7 – critical phase of right-handed targets run; L – the left direction of the target run.

The Fig.1 shows a diagram of visualization of critical phases (positions 2, 7) of aiming weapon movement in shooting at the left-handed target run (position 6), when the target has already entered the final phase of the run and it is still possible to make a shot in the run window with the correct aiming. But it is impossible to reach the center of the target, because the bullet will hit the unfired zone target. It will happen as a result of the continuation of the aiming, and during the flight of the bullets from the shooting line to the target line the target has time to run the rest of the distance and disappear behind the shelter. Thus, the aiming shot in the critical phase of the aiming weapon movement ends with a hit to the unfired zone (position 4) and is counted as a mistake in accordance with the competition rules. The target run time in the critical phase was determined using the following formula:

$t_p = T - t_r$, (1), where

t_p – the target run time in the critical phase;

T – total time of target movement in the window run;

t_r – time of resulting attempt.

According to well-known physical laws, the time of target movement in the critical phase is equal to the flight time of the bullet from the shooting line to the target line, that is:

$$t_p = \frac{S}{V_k}$$, (2) where

t_p – temporal parameters of the critical phase of target run;

S – distance of shooting;

V_k – speed of the bullet flight.

With the help of formula (2), the temporal parameters of the critical phase of the target run were determined, taking into account the speed of the bullets, which in 50 m shooting is 250-420 m/s and in 10 m shooting is 150-190 m/s. For the minimum flight speed of bullets, the time parameters of the critical phase of the target run are as follows: in 50 m shooting t_p = *50 m: 250 m/s = 0,20 c;* in 10 m shooting t_p = *10 m: 150 m/s= 0,07 s.*

Thus, in 50 m target running shooting the temporal parameters of the critical phase of the target run are from 0.20 to 0.07 s, depending on the speed of the bullets, so, according to a series of bullets. At the same time in 10 m target running shooting the temporal parameters of the critical phase of the target run are 0.1-0.05 s depending on the speed of the bullets, that is, according to a series of pellets and a weapon model.

Given that such short time intervals for the athletes are difficult to feel, it is advisable to determine the spatial parameters of the critical phase of the target run. In our opinion, the further visualization during training will contribute to the improvement of the aiming weapon movement. Thus, there is an assumption that the visualization of the spatial and temporal parameters of the critical phase of the target run might improve the aiming of the weapon. This allows us to put forward the hypothesis: the visualization of spatial and temporal parameters of the critical phase of the target run increases the accuracy of the aiming weapon movement and improves the process of technical and tactical training of athletes.

To verify this hypothesis, the spatial parameters of the critical phase of the target run were determined by the author's formula:

$S_p = V_m \times t_p$, (3), where

S_p – spatial parameters of the critical phase of the target run;

V_m – speed of target run;

t_p – temporal parameters of the critical phase of the target run.

The speed of target run was determined by the following formula:

$$V_m = \frac{S_v}{T}$$, (4), where

V_m – speed of target run;

S_v – width of the window of the target run;

T – total time of the target movement in the window run.

According to the competition rules S_v is 10 m in 50 m shooting and 2 m in 10 m shooting. Respectively T is 2,5 s for fast run and 5 s for slow target run both in 50 m and 10 m shooting. On this basis, using the formula (4), there was determined the speed of the targets run of the right and left directions for the fast and slow run. It was the following. In 50 m shooting fast run V_m = *10 m : 2,5 s = 4 m/s;* slow run V_m = *10 m : 5 s = 2 m/s.* In 10 m shooting fast run V_m = *2 m : 2,5 s = 0,8 m/s;* slow run V_m = *2 m : 5 s = 0,4 m/s.*

Using the formula (3), there were determined the spatial parameters of the critical phase of the fast-run target. In 50 m shooting : S_p = *4 m/s * 0,2 s = 0,8 m = 80 cm.* In 10 m shooting S_p = *0,8 m/s * 0,1 s = 0,08 m = 8 cm.* The spatial parameters of the critical phase of the slow run targets were respectively 40 cm and 4 cm.

We have also determined the spatial and temporal parameters of the critical phase of the target run in shooting at 50 m and 10 m, which essentially complements the theory of shooting and form an idea of the effective range of the aiming shot. In order to further improvement of technical and tactical skills of athletes, it becomes clear and expedient to reduce the target phase of the aiming weapon movement and complete the shot before the entrance of the target area to the critical phase of the target run.

With the aid of the patented invention 16989 Ukraine, IPC F41J 5/00 "Device for visualization of the critical phase of the aiming weapon movement in shooting at running targets", the parameters of shooting at the targets of the fast and slow run of the left and right directions in the GP-12 exercise were determined. There were registered parameters of shooting in standard conditions, parameters of shooting with the visualizer of the critical phase of the target run and parameters of shooting after using the visualizer. There were performed 30 scoring shots (Table 1).

Table 1

Parameters of technical and tactical actions of athletes in fast running target shooting before the visualization of the critical phase, ms (n = 310; p <0,001)

Parameters	Reset of weapons (ready position)	Aiming movement	Making shot	Remaining time	Time control of the critical phase	Errors
M	*446*	*1346*	*1792*	*707*	*207*	*93*
m	*60,52*	*414,21*	*432,95*	*432,95*	*432,95*	
r_l	*	*0,244*	*0,373*	*-0,373*	*-0,373*	*0,266*
r_p	*0,244*	*	*0,991*	*-0,991*	*-0,991*	*0,829*
r_c	*0,373*	*0,991*	*	*-1,000*	*-1,000*	*0,831*
r_r	*-0,373*	*-0,991*	*-1,000*	*	*1,000*	*-0,831*
r_s	*-0,373*	*-0,991*	*-1,000*	*1,000*	*	*-0,831*
r_n	*0,266*	*0,829*	*0,831*	*-0,831*	*-0,831*	*

Note: ***M*** – the average sample size; ***m*** – standard deviation; r_l - correlation coefficient of weapon reset with parameters of shooting; r_p - correlation coefficient of the aiming weapon movement; r_c – correlation coefficient of parameters of series of the shot; r_r - correlation coefficient of the remaining time; r_s - correlation coefficient of time control of the critical phase; r_n - correlation coefficient of critical errors.

There were registered time control parameters in the series of the shot, which characterize insufficient stability of the aiming weapon movement. In 93 cases there were registered errors: the time control of the critical rate was less than 500 ms, which are needed to compensate for the reset of weapon and the time of flight of the bullet.

The standard deviation of the parameters of the aiming weapon movement is 414 ms and characterizes the considerable variation of the investigated shooting parameter without the visualizer of the critical phase of the target run.

The parameters of the aiming weapon movement have a strong correlation with the time control of the critical phase (*r = -0,991*), (Table 1). Parameters of shooting with the visualizer are shown in the Table 2

Table 2

Parameters of technical and tactical actions of athletes in fast running target shooting with the visualization of the critical phase, ms (n = 310; p <0,001)

Parameters	Reset of weapons (ready position)	Aiming movement	Making shot	Remaining time	Time control of the critical phase	Errors
M	*437,4*	*1170*	*1608*	*892,5*	*392,5*	*36*
m	*60,46*	*313,81*	*333,98*	*333,98*	*333,98*	
r_l	*	*0,248*	*0,414*	*-0,414*	*-0,414*	*0,190*
r_p	*0,248*	*	*0,985*	*-0,985*	*-0,985*	*0,602*
r_c	*0,414*	*0,985*	*	*-1,000*	*-1,000*	*0,600*
r_r	*-0,414*	*-0,985*	*-1,000*	*	*1,000*	*-0,600*
r_s	*-0,414*	*-0,985*	*-1,000*	*1,000*	*	*-0,600*
r_n	*0,190*	*0,602*	*0,600*	*-0,600*	*-0,600*	*

Note: ***M*** – the average sample size; ***m*** – standard deviation; r_l - correlation coefficient of weapon reset with parameters of shooting; r_p - correlation coefficient of the aiming weapon movement; r_c – correlation coefficient of parameters of series of the shot; r_r - correlation coefficient of the remaining time; r_s - correlation coefficient of time control of the critical phase; r_n - correlation coefficient of critical errors.

According to Tables 1 and 2, we see that in the process of shooting with the visualizer the standard deviation of the aiming weapon movement decreases from 414 ms to 313 ms in comparison with the shooting in standard conditions. Also, the number of critical errors decreases from 93 to 36, correlation 0.985. Taking into account that in competition it is allowed to shoot without a visualizer, we have measured the parameters of shooting in standard conditions after using the visualizer (Table 3).

Table 3

Parameters of technical and tactical actions of athletes in fast running target shooting after the visualization of the critical phase, ms (n = 310; p <0,001)

Parameters	Reset of weapons (ready position)	Aiming movement	Making shot	Remaining time	Time control of the critical phase	Errors
M	*438,1*	*1189*	*1627*	*872,5*	*372,5*	*17*
m	*58,56*	*304,72*	*320,01*	*320,01*	*320,01*	
r_l	*	*0,172*	*0,346*	*-0,346*	*-0,346*	*0,179*
r_p	*0,172*	*	*0,984*	*-0,984*	*-0,984*	*0,471*
r_c	*0,346*	*0,984*	*	*-1,000*	*-1,000*	*0,481*
r_r	*-0,346*	*-0,984*	*-1,000*	*	*1,000*	*-0,481*
r_s	*-0,346*	*-0,984*	*-1,000*	*1,000*	*	*-0,481*
r_n	*0,179*	*0,471*	*0,481*	*-0,481*	*-0,481*	*

Note: ***M*** – the average sample size; ***m*** – standard deviation; r_l - correlation coefficient of weapon reset with parameters of shooting; r_p - correlation coefficient of the aiming weapon movement; r_c – correlation coefficient of parameters of series of the shot; r_r - correlation coefficient of the remaining time; r_s - correlation coefficient of time control of the critical phase; r_n - correlation coefficient of critical errors.

The comparison of the parameters of the aiming weapon movement, the remaining time to the end of the run, errors and correlation confirmed the hypothesis that the training with the visualizer has a positive effect. The parameters of the aiming weapon movement stabilized to variability in 304 ms, the time control of the critical phase increased from 207 ms to 372 ms, the number of critical errors-failures decreased from 93 to 17 at a correlation of 0.984.

The results of mathematical and statistical processing of the average indicators of testing masters of international class in fast running target shooting in standard conditions are summarized in Table. 4. From the data Table 4, 5, and 6 we see that in the process of shooting with the visualization the standard deviation of the aiming weapon movement decreases from 1407 ms to 1309 ms in comparison with with the shooting in standard conditions. The remaining time to complete the shot has increased from 689 ms to 770 ms.

Table 4

Parameters of technical and tactical actions of Ukrainian national team athletes in fast running target shooting before the visualization of the critical phase, ms *(n=120; p<0,001)*

Parameters	Reset of weapons (ready position)	Aiming movement	Making shot	Remaining time
M	*404*	*1407*	*1811*	*689*
m	*82*	*464*	*521*	*521*
r_l	*	*0,647*	*0,735*	*-0,735*
r_p	*0,647*	*	*0,993*	*-0,993*
r_c	*0,735*	*0,993*	*	*-1,000*
r_r	*-0,735*	*-0,993*	*-1,000*	*

Note: ***M*** – the average sample size; ***m*** – standard deviation; r_l - correlation coefficient of weapon reset with parameters of shooting; r_p - correlation coefficient of the aiming weapon movement; r_c – correlation coefficient of parameters of series of the shot; r_r - correlation coefficient of the remaining time.

Table 5

Parameters of technical and tactical actions of Ukrainian national team athletes in fast running target shooting with the visualization of the critical phase, ms *(n=120; p<0,001)*

Parameters	Reset of weapons (ready position)	Aiming movement	Making shot	Remaining time
M	*421*	*1309*	*1730*	*770*
m	*92*	*405*	*462*	*463*
r_l	*	*0,554*	*0,684*	*-0,685*
r_p	*0,554*	*	*0,986*	*-0,986*
r_c	*0,684*	*0,986*	*	*-1,000*
r_r	*-0,685*	*-0,986*	*-1,000*	*

Note: ***M*** – the average sample size; ***m*** – standard deviation; r_l - correlation coefficient of weapon reset with parameters of shooting; r_p - correlation coefficient of the aiming weapon movement; r_c – coefficient of correlation of parameters of series of the shot; r_r - coefficient of correlation of the remaining time.

Table 6

Parameters of technical and tactical actions of Ukrainian national team athletes in fast running target shooting after the visualization of the critical phase, ms ***(n=120; p<0,001)***

Parameters	Reset of weapons (ready position)	Aiming movement	Making shot	Remaining time
M	*404*	*1407*	*1811*	*689*
m	*59*	*520*	*573*	*573*
r_l	*	*0,598*	*0,688*	*-0,688*
r_p	*0,598*	*	*0,993*	*-0,993*
r_c	*0,688*	*0,993*	*	*-1,000*
r_r	*-0,688*	*-0,993*	*-1,000*	*

Note: ***M*** – the average sample size; ***m*** – standard deviation; r_l - correlation coefficient of weapon reset with parameters of shooting; r_p - correlation coefficient of the aiming weapon movement; r_c – coefficient of correlation of parameters of series of the shot; r_r - coefficient of correlation of the remaining time.

Discussion

Thus, the nature of the paradoxical phenomenon of the aiming weapon movement in running target shooting was revealed. Previously it was unknown and not documented in scientific literature and practice. In the paradox of the aiming weapon movement during the performance of running target shooting with the apparent truth of its elements (correct aiming and pressing on the trigger), there is an error and contradiction with the common beliefs. The error and contradiction are explained by the presence of the critical phase of the target run and, accordingly, the critical phase of the aiming weapon movement.

The nature of the critical phases of the aiming weapon movement in running target shooting is based on random uncontrolled misses during proper targeting and pressing a trigger in the final phase of the target run. Also, they differ from previous scientific researches by identifying the critical phases of the target run depending on the speed of the bullet flight and the shooting distance, which was previously unknown and not documented in scientific literature and practice.

The generalization of the results of the study made it possible to determine the model characteristics of running target shooting in slow and rapid movement of the right and left directions. Consequently, there is a statistically significant strong correlation between the aiming weapon movement and the critical phases. Based on the revealed connections, there was proved the dependence of the parameters of the phase of the aiming weapon movement t_p on the changes of the parameters of the time control of the critical phase t_r in the "Running Target" exercises.

Also, on the basis of detected objectively existing stable bonds, which are repeated in the shooting conditions with the visualization of the critical phase of the target movement, we have determined the pattern of improvement of the aiming weapon motion in running target shooting: the precision of the aiming weapon movement increases in the process of firing with the visualization of the critical phase of target run. The hypothesis is confirmed.

Model characteristics of running target shooting at slow speed are the following: the reset of weapons / ready position (S_k = 341 ± 27 ms, ms ≈ *0,35±0,03 s*); the aiming weapon movement (P_p = 4083 ± 102 ms, *ms* ≈ *4,08±0,10 s*); series of the shot (C_p = 4423 ± 106 ms, *ms* ≈ *4,42±0,11 s*); reserve phase of the aiming weapon movement (t_r = 577 ± 105 ms, ms ≈ *0,58±0,10 s*); temporal parameters of the paradoxical phase of the target run (at a minimum flying speed of bullets at 50 m t_p = 0,20 s; with a minimum flight speed of bullets at 10 m t_p = 0,10 s); linear parameters of the paradoxical phase of the target run (in shooting 50 meter rifle S_p = 40 cm; in shooting air rifle 10 m S_p = 4 cm).

Model characteristics of running target shooting of fast run are the following: the reset of weapons / ready position (S_k = 404 ± 59 ms, ms ≈ *0,40±0,06 s*), the aiming weapon movement (P_p = 1407 ± 119 ms, *ms* ≈ *1,41±0,12 s*); series of the shot (C_p = 1811 ± 125 ms, *ms* ≈ *1,81±0,12 s*); reserve phase of the aiming weapon movement (t_r = 689 ± 165 ms, *ms* ≈ *0,69±0,16 s*); temporal parameters of the paradoxical phase of the target run (at a maximum flying speed of bullets at 50 m t_r = 0,12 s; with a maximum flight speed of bullets at 10 m t_r = 0,05 s); linear parameters of the paradoxical phase of the target run (in shooting 50 meter rifle S_p = 80 cm; in shooting air rifle 10 m S_p = 8 cm).

The study confirmed the data [3; 4; 5; 6; 7; 8] on optimization of technical and tactical actions of athletes, methods of improvement of skills on the basis of application of simulators and other technical means of program-target management by pedagogical process. There were also confirmed the provisions of the quantitative characteristics of the dynamics of the body resistance of athletes in the Ready position in solving problems of different pedagogical orientation [2].

The obtained results confirm the general pattern of increasing the efficiency of shooting by reducing the speed of projection weapon movement in the target area [1].

The concept of the optimization of the shooters' training was confirmed. It summarizes the interdependence of the spatial and temporal parameters of the technical and tactical actions of athletes in the process of exercises. It was proved by the increasing of the accuracy of aiming and completing the shot by minimizing the speed of projection of the weapon movement in the target area [1; 2].

In the process of studying the technical and tactical training of athletes in running target shooting there were obtained the results that supplement the results of previous research [11; 12]. The method of visualizing the critical phases of the target movement received a further development. This method is based on the automatic emergence of a visualizer since the start of the target run and disappearing during a shot. The scientific and methodological support of the Ukrainian national team in rifle shooting was supplemented [9; 10; 13; 14]. It was connected with the assessing of various aspects of their preparedness on the basis of their model characteristics.

The new data obtained as a result of the research include:

- improving the aiming weapon movement in running target shooting – the accuracy of the aiming weapon movement increases during the shooting with the visualization of the critical phases of the target run;
- definition of model characteristics of running target shooting of slow and fast run, left and right directions of movement;
- determination of linear parameters of the visualizer of the critical phase of the target run;
- development and verification of the device for visualizing the critical phase of the aiming weapon movement in running target shooting.

The totally new data in the work are: the nature of the critical phases of the aiming weapon movement in running target shooting was disclosed. It is based on the random uncontrolled misses during proper targeting and pressing on the trigger in the final phase of the target run; The spatial and temporal parameters of the critical phase of the aiming weapon movement were determined.

The results of the research for the first time solved the problem situation of uncontrolled misses in shooting exercises and the final series of running target shooting. The results of international competitions prove the efficiency of such approach.

Conclusions

The efficiency of the visualization of the paradoxical phase of the aiming weapon movement increases by indicators of accuracy among skilled athletes by 13%, among masters of the international class – by 7%.

Model characteristics of shooting at running targets of slow speed are, in particular, the reset of weapons / ready position (S_k = 341 ± 27 ms); the aiming weapon movement (P_p = 4083 ± 102 ms); series of the shot (C_p = 4423 ± 106 ms); reserve phase of the aiming weapon movement (t_r = 577 ± 105 ms); temporal parameters of the paradoxical phase of the target run (at a minimum flying speed of bullets at 50 m t_p = 0,20 s; with a minimum flight speed of bullets at 10 m t_p = 0,10 s); linear parameters of the paradoxical phase of the target run (in shooting 50 meter rifle S_p = 40 cm; in shooting air rifle 10 m S_p = 4 cm).

Model characteristics of running target shooting of rapid run are, in particular: the reset of weapons / ready position (S_k = 404 ± 59 ms), the aiming weapon movement (P_p = 1407 ± 119 ms); series of the shot (C_p = 1811 ± 125 ms); reserve phase of the aiming weapon movement (t_r = 689 ± 165 ms); temporal parameters of the paradoxical phase of the target run (at a maximum flying speed of bullets at 50 m t_r = 0,12 s; with a maximum flight speed of bullets at 10 m t_r = 0,05 s); linear parameters of the paradoxical phase of the target run (in shooting 50 meter rifle S_p = 80 cm; in shooting air rifle 10 m S_p = 8 cm).

A new type of shooting pattern for running targets has been developed using the well-known interactivity principle. It differs from previous solutions by having electronic functions of simulating the shooting process in running target in the classification exercises and final series of the Olympic program with the visualization of parameters of the paradoxical phase of the target run.

Conflicts of interest

The authors state that there is no conflict of interest.

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