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Original article

SOLUTION AND RESULTS FOR MEASURING THE REACTION TIME AND THE EXECUTION TIME IN KARATE TECHNIQUE

PETRE CĂTĂLIN[1], ENOIU RĂZVAN SANDU[2, 3]

Abstract

Aims. To present an innovative method of measuring speed, respectively reaction time and execution time.

The method used is based on a specially designed device, which uses the facilities of an electromyograph capable of recording synchronously, with high precision, a multitude of information channels, presented in the form of variations in electrical voltage. The measurements and settings of the device used were made specifically for basic karate techniques. The tested subjects belong to the national karate group, the measurements taking place at the National Research Institute for Sports in Bucharest.

The results include accurate measurements of the times of the stages in which the total time is divided, with emphasis on the two forms of manifestation of speed.

The research conclusions confirm the efficiency of the device and the methods used, in order to measure the reaction time and the execution time.

Key Words: reaction time, execution time, karate, electromyograph.

Introduction

The present study was made out of the need to quantify these forms of speed manifestation, in order to obtain information that can be the basis of new training methods, thus optimizing reaction time and execution time.

In addition, this study brings a contribution to the limited knowledge in different areas: motor, physiological, psychological, technical and tactical in the training method of karate.

Study hypotheses

1. In order to develop a motor quality or a form of its manifestation, it is necessary, first of all, that it be quantified.
2. It is assumed that the measurement of reaction time and execution time can be performed using an electromyograph.

This study aims to demonstrate that the measurement of reaction time and execution time can be achieved by methodologies that use the properties of an electromyograph, which ensures the certainty of the possibility of a synchronous recording, of high precision, of several information channels that come in the form of variations in electrical voltage.

The use of a recording equipment, designed for purposes other than those of this paper, has helped to develop and use measurement techniques, this has led to the enrichment of methods for measuring the times of events in combat sports. These results have been recorded and interpreted in order to confirm this hypothesis. The results were correlated with observations on some technical features of the sport presented.

The technical process that was measured

Kumite uses only some of the techniques found in karate. Statistically, in terms of efficiency, an arm procedure called KIZAMI TSUKY was used.

Explanation of the procedure: From the guard position (kamae) - the feet fully in contact with the ground, with the tips facing forward, the width of the position equal to the distance between the shoulders, the length of the position one and a half steps, the knee bent forward so that its projection on the ground to fall on the big toe, back leg slightly bent, back straight, arms flexed forward. The punch will be executed with the arm in front, with the fist clenched in the opponent's face area (jodan level), the other arm being fixed with the elbow facing back and with the fist in the belt area, with the fingers oriented towards the shoulder to respect the action-reaction principle (Fig 1.). (Frederic, L. 1991)

[1]"Dunărea de Jos" University of Galați, Strada Gării nr 63 – 65, Galați, România
[2]Motric Performance Department, Transilvania University of Brașov, Romania
[3]"Dunărea de Jos" University of Galați, Strada Gării nr 63 – 65, Galați, România
Corresponding author: catalin.petre@unitbv.ro, razvan.enoiu@unitbv.ro
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Fig. 1

Ways to apply the strike:

1. By changing position to reach the target - but without moving - if the opponent is at a short distance or enters a short distance for the attack.
2. By changing the position to reach the target - but also make a jump (yuri ashi) - if the opponent is at a medium-to-large distance.

Regardless of how the punch is applied, the arm goes in a straight line, without signaling the movement, with the elbow passing by the body, without making oscillations on the trajectory towards the target. At the same time as the acceleration, at the end of the procedure, the forearm makes a pronation movement, followed by a very short isometric contraction, to fix the strike (kime). (Sugiyama, S. 2005)

Exploring concepts

1. The concept of speed

In kinematics, the concept of speed is defined as the ratio of the distance traveled by a body between two distinct positions and the time in which this takes place.

$s=\frac{d}{\Delta t}$ where: s= speed; d= distance; Δt= time. (Tilling, A. 2004-2021)

2. The concept of time

According to DEX[1], the concept of time is defined as duration, period, which corresponds to the development of an action, a phenomenon or an event. Another definition of it can be "moment", which leads to the use of the notation Δt to designate the duration or interval, respectively the difference between two distinct moments of time.

3. The concept of reaction speed

From the TEFS[2] point of view, this concept "represents the time elapsed between receiving a stimulus and the appearance of the motor response" (Dragnea et al., 2006)

From a physical point of view, the concept of reaction speed is not used correctly, the reason being the lack of a distance that can be related to the duration, having only the duration itself between two distinct events: the appearance of the stimulus and the beginning of the movement.

This is the reason for the preference for using the concept of "reaction time" to characterize the ability to respond, through movement, to a stimulus. Therefore, these notions, although similar, are based on different concepts.

4. The concept of execution speed

According to TEFS, speed is "the ability to perform a motor act or action as quickly as possible. It is measured by the time elapsed between the beginning and the end of a movement "(Dragnea et al., 2006)

From a physical point of view, the execution speed represents the ratio between $\frac{distance}{time}$, the value of time being equal to the difference between the final time and the initial time.

Based on the ideas presented above, it is emphasized that the execution time represents the time elapsed from the moment a body is set in motion, until the moment when it passes into the predetermined resting state.

Similar to the reaction speed, the execution speed and the execution time are similar, but not identical.

Electromyography

Electromyography is a technique that measures the electrical activity of muscles. The measurement is made with the help of electrons placed on the skin, which can be placed along a muscle, at its ends or inside the muscle (with needle electrodes), the recording is obtained called electromyogram (EMG).

The electromyogram records the signals of the motor neuron that stimulates the muscle fibers in the motor plate, the electrical impulses being conducted along each fiber as it depolarizes. (Mills, K. R. , 2005)

Through this field, the way to obtain the synchronization information on the unit of time was used, but without placing electrodes on the muscles. In a test, an electromyogram is obtained, which indicates 3 signals: the moment when the light stimulus lights up, the moment when the arm moves and the end of the procedure.

Technical description of the test method

[1] Explanatory Dictionary of the Romanian Language

[2] Theory of Physical Education and Sport

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According to Fig.2 the test device consists of several parts: the pillow (target) which is made of a metal frame that supports a pillow made of a material and a special texture to withstand shocks. On this pillow were attached two metal strips placed at a distance of 4 cm from each other, connected to a device that signals the closing of the circuit. An LED is attached to the top of the pillow to signal when the total time of the test begins. On the front of the fist, the subject has a metal band glued, and by hitting, he closes the circuit on the pillow.

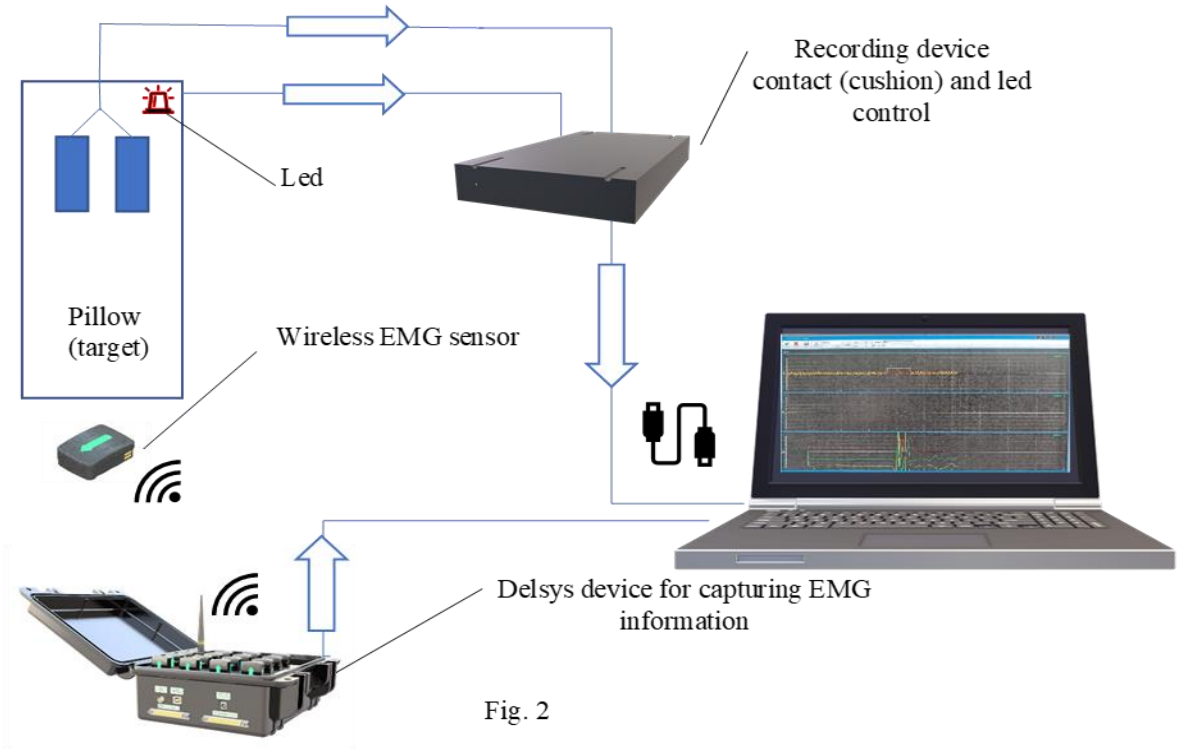


Fig. 2

All this information is recorded by a device and, with the help of special software created for this test, is displayed on a graph very similar to the one used in the electromyogram. The Tringo device has been adapted to record movement and works like this: on the arm is placed a wireless sensor that transmits information in real time, this information, in the case of measuring time, being reduced to the 3 axes of movement. In conclusion, this device signals the moment when the arm moves, no matter in which direction or plane.

Presentation of results

The athletes' results were measured in milliseconds and exposed from three points of view (table 1, chart 1):

- total time - the time elapsed from the moment of triggering the visual stimulus until reaching the target;

This device sends real-time information to the computer where it is synchronized per unit of time, using the software.

Test methodology

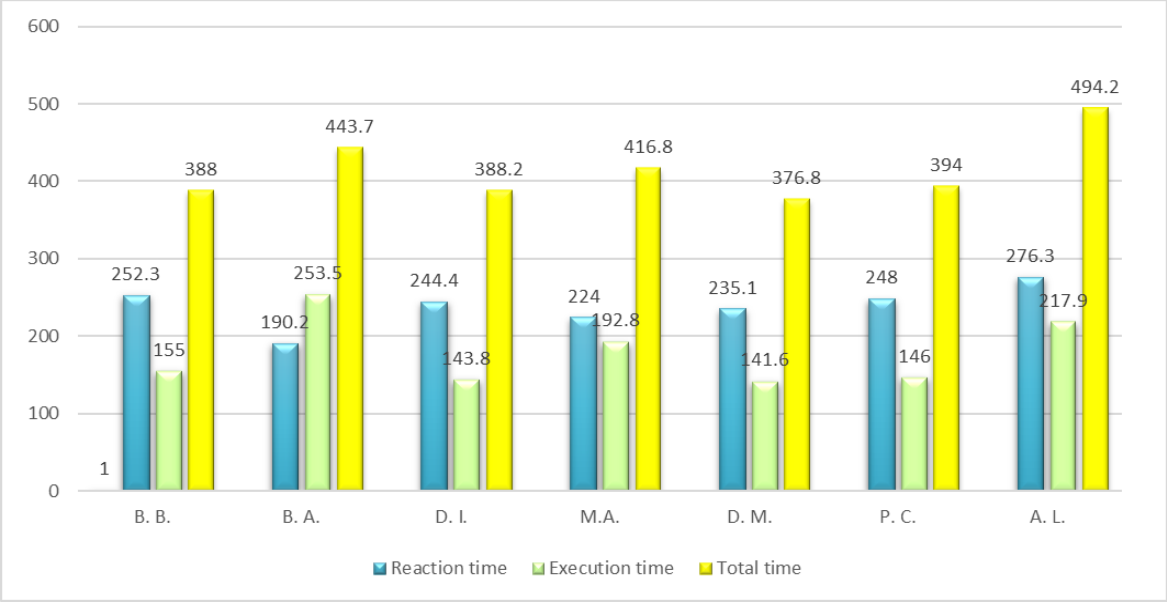
Each subject is positioned at arm's length from the target, in the guard position, on the dexterous side, a position used in kumite matches in competitions. From this position, subjected to random visual stimuli, the subject performs 14 shots on target, respecting the technique of the measured procedure. From these 14 strokes, the best and weakest time is excluded and an arithmetic mean is made to find out the average value of the executions.

- reaction time - the time elapsed from the moment the visual stimulus is triggered, until the arm that executes the blow moves;
- execution time - the time elapsed from the moment the arm moves until it reaches the target

Nr.	Subjects	Average of reaction time (ms)	Average of execution time (ms)	Average of total time (ms)
1	B. B.	252.3	155	388
2	B. A.	190.2	253.5	443.7
3	D. I.	244.4	143.8	388.2
4	M. A.	224	192.8	416.8
5	D. M.	235.1	141.6	376.8
6	P. C.	248	146	394
7	A. L.	276.3	217.9	494.2
Standard deviation		26.7	43.8	41.7

Tabel 1- Average measurement

Chart 1



Conclusions

Following this research, combining sensory technology with the concepts of speed, both physically and specific to motor quality, a method of measuring reaction time and execution time was designed. The method, related to a karate technique, uses the principles of an electromyograph, thus managing to determine high-precision measurements.

By using this device, hypothesis 1 is confirmed, succeeding in successfully quantifying the times of a movement, in order to design specific programs for optimizing these times, in order to develop the targeted motor quality.

From the statistical interpretation of the averages, it appears that the reaction time is longer compared to the execution time.

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