STUDY ON THE POSSIBILITY OF HIGHLIGHTING INVARIANTS OF MOTION IN MARTIAL ARTS KATA EXERCISES

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Abstract

Introduction: *Martial arts are practiced both as a hobby, for physical and psychological training, as well as professional sport with its own rules and competitions. How is performed every move in karate is highly important. In this article we analyze some movement in kata exercises.* ***The purpose*** *of this paper is to demonstrate the existence of stable aspects of movement - motion invariant during the execution of technical elements of kata. Our application was made on the kata Heian Nidan.* ***Working methodology*** *consisted in achieving some tests relating to kinematic characteristic of motion, in the kata mentioned before. We use an inertial navigation system that contains 17 sensors - MVNBiomech, produced by Dutch company XSENS Technologies BV. Female athlete tested holds a black belt, she practice karate for 8 years and have 22 years old.* ***The results*** *obtained refers to the oscillation of CGM height, on a total of 12 repetitions from kata sequence selected. The average values of height oscillation to CGM = max. 92 cm and min. 72 cm., St. dev. is Min. = 0.002 and Max.= 0,013 while C.V. = max. 1.7%.* ***Conclusions*** *drawn from the above results indicate that the average values are representative and homogeneity is high. Thus we can say that the invariants (general form of repetitive motion), can be recognized in the development of technical elements of martial arts kata exercises (and we can say in other sports). This emphasis of movement patterns can be useful both referees and coaches involved in the educational process.*

Keywords: *movement, analysis, karate, kata Heian-Nidan*

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Introduction

Karate as a sport, permanently enjoyed by a strong sympathy from several categories of people, from children to older persons, mens and womens for pleasure or for competition. It is well known that this sport is divided in three main categories: - kihon (where students learn simple technical elements), - kata (where karateka learn how they can put together successive technical elements, symbolizing a fight with an imaginary opponent), - kumite (is the effective fight on the mat, with a direct opponent).

Invariants or invariable phenomena are opposite the variability and can be defined as: "*Invariant* (sf) maintaining unchanged of a sizes, a system of numbers in a certain transformation; stability and fixity. (<fr.invariance) "(http://dexonline.ro/definitie/invariance).

Regarding the kata chosen to be executed during testing, Amalinei 2010 says: "In the kata Heian Nidan is studied kokutsu dachi position and the corresponding displacement". In this position, as indeed in most of the techniques of martial arts (not only the position or displacement) is of crucial importance position and control the center of mass of the athlete.

Other authors claim that a kata, Heian Nidan as is, "teaches practitioners how to execute various techniques while moving forward, backward or sideways, with different speeds, without losing balance, coordination, muscle control and concentration" (Chandler. RC, 1998, wp).

Bruce Lee brings into discussion the concept of kinesthetic perception and say on this,that is the ability to feel the contraction and relaxation of muscles (ie athlete to be able to know at any time how operate a muscle) (Lee B., 1992, p. 45).

What is to remember here, is that balance means a permanent self control of the center of mass (weight). This is strengthened by some experts: „Difficulties in maintaining the balance are determined by the size of the base of support and the ability to produce muscle momentum" (Chapman, 2008, p. 60).

It is also very important to take into account the regulations

provisions, which require four main criteria of equal importance, when considering an athlete performing a kata. The main criteria are: "(1) compliance (with form and standards of each school); (2) the correct technique (by: positions, technical elements, transitional movements, timing, synchronization, proper breathing, concentration - kime); (3) athletic performance (proving: strength, speed, balance, rhythm); (4) technical difficulty of the executed kata ". (W.K.F., 2013, pp. 24-25).

When athlete learn an element or a movement, experts say that in the cerebral cortex is formed so-called motor engrams, about the element to be learned. "When motor engrams are better fixed, muscle activities takes execution speed, intensity and complexity. In fact, engrams will not only achieve the desired movements but will inhibit synapses wich is not necessary to enter into scheme of movements. (Sbenghe, 2008, p. 350).

We believe that while learning the technical elements from martial arts (kihon) and logical sequence of learning kata exercises, the athlete catch some engrams, some split schemes to facilitate learning, following that the student, through repetition be able to master very well and achieve their binding, so as to result in final the kata exercise. In martial arts, uses the expression "the practitioner must become one with the technique" (Tokitsu, 2010, p. 25).

The invariant trajectories, confirms that the technique of exercise is properly acquired and may lead to better stability, balance and coordination of movements, wich can influence positively the final grading in kata's executions.

The purpose of this paper is to demonstrate the existence of stable aspects of movements (invariants of motion) that would later constitute the reference for those involved in the body of competitions judges, referees, and a tool for providing real-time feedback to coaches and specialists, dealing with preparing karateka athletes.

Hypothesis: In this paper we want to check if, through MVNBiomech - Xsens equipment, can highlight the existence of invariants (general form, repeatable of the movement) in some complexes exercises of kata, from martial arts.

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Research Methodology

In this paper we performed an investigation (testing, data collection and processing), of kinematic characteristics, in movements from shotokan kata "Heian Nidan", with MVNBiomech system, produced by Dutch company XSENS Technologies BV, which uses inertial motion transducers, and an advanced mathematical apparatus for identifying movement for a total of 23 body segments, according to the segmentation model approved by the International Society of Biomechanics (Wu G. et al., Journal of Biomechanics, 38 (2005) 981- 992).

The experiment was conducted in august 2014, at National Institute for Sport Research Bucharest in biomotric laboratory. Our subject was a female athlete, shotokan karate practitioner, member of CS Aiko Bucharest. The effective testing consisted in performing a sequences from Heian Nidan kata, specific in shotokan karate. This sequence took about 3.5 seconds and comprised six technical elements (conf. Fig. 1). To see any similarities between the patterns of movement on this section of exercise, athlete has made a total of 12 repetitions of this portion of the kata.

Must mention that we calculate, for center of mass height oscillation, indicators wich can determine the central tendency, trace of the movement (average), or indicators of variation such as: - standard deviation (St.dev.) and coefficient of variance (C.V.), for all synchronized data group, of registered athlete.
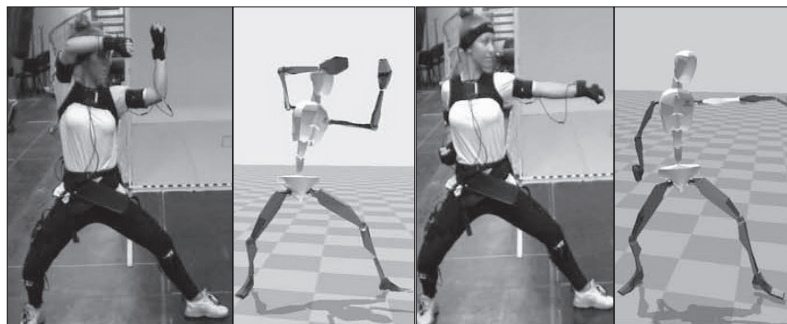

Fig. 1 . Comparative presentation of two technical elements performed by the sportswoman, taken with a foto camera and a capture from MVN Biomech program

(capture and fotography are made at different repetitions).

Recorded images with MVN Biomech technology were checked and adjusted by MVN Studio software, in the limits permitted by this and to comply anatomical model. After, all data was exported into Excel document in which we could analized, process data, and were calculated statistic indicators, that interested us (average, Std. dev. and C.V.), and after were generated all graphs.

Results

In Fig. 2 are presented height oscillation on CofM for all 12 repetitions of kata recorded. It is clearly to observe that the first part of movement is almost perfect, indicating a note of invariance. After lowering moment, CoM trajectories split in each repetition very little, but the general form of motion is almost identical, indicating a good invariance of the movement throughout the execution. I highlighted it with green arrows marked on the chart.

The athlete starts at a height of about 92 cm, descends to about 70 cm and the movement ends around 78 cm height. After completing the descent phase, we observe also bottom three curves that are generated by that karateka working with upper limbs, which produces a slight oscillation of CofM. However this oscillation is common to all 12 repetitions which highlights the invariance of movements.
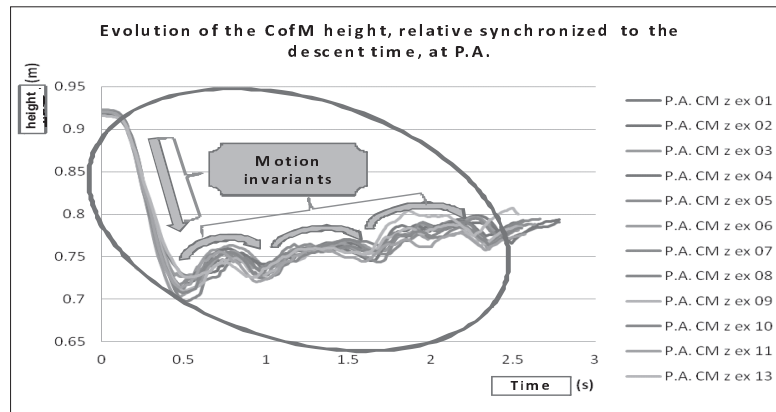

Fig. 2. The synchronized CofM height oscillation and the indication of invariants present on the movements trajectory of all repetitions, at P.A.

In figure 3 we present the mean trajectory of 12 repetitions performed by athlete. There is a slight ascent of the CofM, a possible cause is the movement of arms, wich initially running to the left and then to the right. Viewed from the kata correctness standpoint, this ascent of CofM is not indicated, because it may negatively affect other movements or technical elements which are made by the karateka.
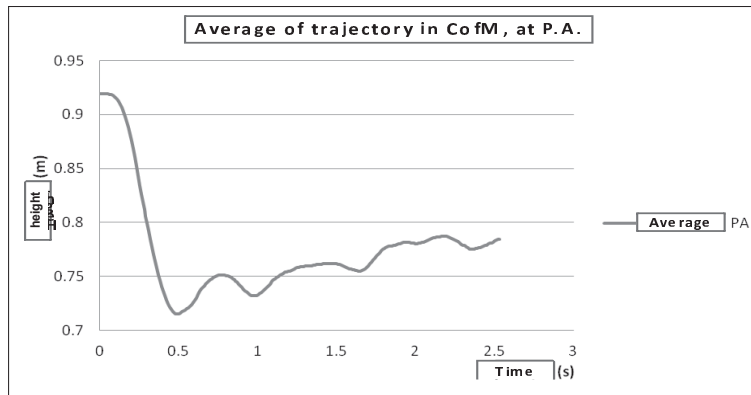

Fig. 3. The CofM evolution average of the 12 exercises analyzed at P.A.

In what concerns the standard deviation presented in fig. 4, we can notice low values ranging from 0,002 to 0,013. Specialized literature tells us that standard deviation is an indicator of the representativeness of the average, "the bigger standard deviation, generate the greater unrepresentative means for the row of data" (Galea, 2010, p. 43). When looking at the St. dev. one can say that, in our case the average is highly representative.
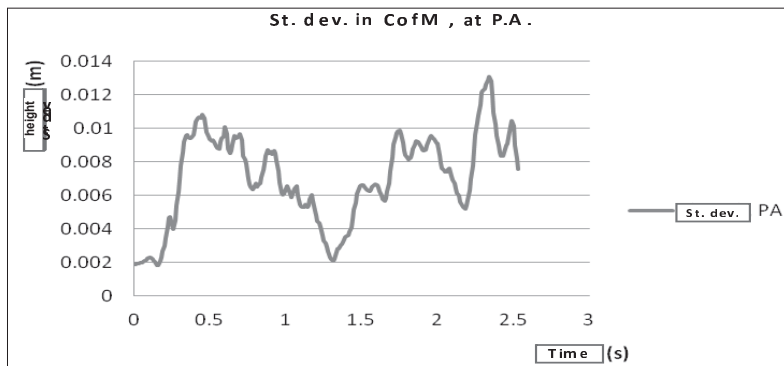

Fig. 4. Reprezentation St. dev. on CofM evolution for all 12 P.A. in analyzed kata.

Figure 5 illustrates the CV(%) of the CofM oscillation, at the 12 repetitions of the chosen and recorded kata exercise performed by the sportswoman. It is noticeable that this ranges from 0,2 to 1,7 % are very good, values that represent a very high homogeneity.

Some authors consider that a group is homogeneous at values that do not exceed 30 % (Murări?a, 2009). Other authors make a much tighter classification of the CV and claim that: "a group is homogeneous if the CV values reach a maximum of 10%; 10% to 20% can signify a population relatively homogeneous; 20% to 30%, a population relatively heterogeneous, and over 30% indicates a population heterogeneous" (Dragomirescu, 2009, p. 76). Even with this classification, in the present case we are dealing with a high homogeneity.

Legend:
- CofM = (general) center of mass; - St. Dev. = standard deviation;
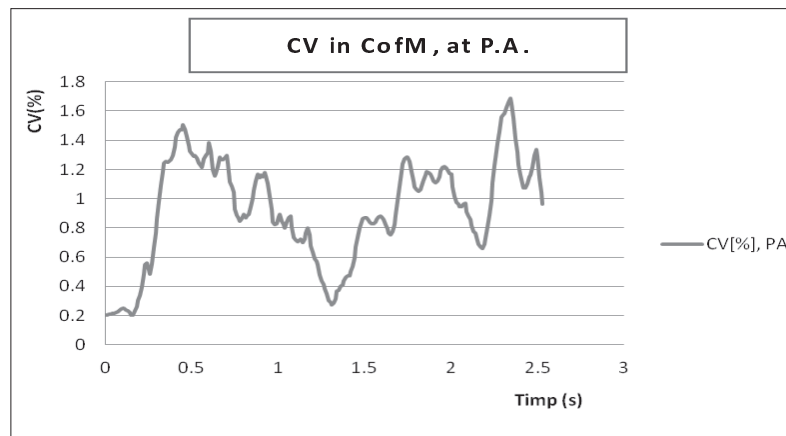- CV = coefficient of variability; - Average = mean.

Fig. 5. Representation of CV at the CofM parameter
for the 12 exercises analyzed at the P.**A.**

Conclusions and discussions

We note that the hypothesis is confirmed in the sense that: - we found after tests conducted and after data processing, using a modern equipment for measuring kinematic movements, that

invariants (general form of repetitive movements), can be found in the deployment of some technical elements from kata exercises, and that these invariants are recognizable, can be repeated by athlete, from a movement to another (by the same person).

Taking into consideration all of the statements presented above, we believe that such a method of movement invariants determination can represent an important tool for coaches involved in the sports trainign process, instrument that can provide precise feedback concerning the corectedness of the technical execution, in real time.

We consider that this method can also represent a useful tool for the referees who evaluate the kata exercises, eliminating almost completely the presumption of subjectivism, due to the swiftness of the performance, the insufficient experience or shalowness of assessment.

We believe that the subject studied in this paper should be researched further, as this technology can be put to a wider use in other sports areas (especially individual sports) such as gymnastics, tennis, some sections from athletics, and so on.

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SITUATIONS OF STRESS PRE-COMPETITIVE OF YOUNG BRAZILIAN´S ATHLETES

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Abstract

*This study **aims** to identify the level stress pre-competitive for young athletes who participate in school sports competitions. By a descriptive research, the sample established for convenience, with a total of 207 participants (n:207) of both genders, aged between 14-18 years (average of 15.89±0.78 years), 85 was boys (average of 15.87±0.86 years) and 122 was girls (average of 15.90±0.72 years) all from the City of Carapicuíba's – São Paulo, Brazil; the instrument used was the LSSCPI. The **results** shows no significant difference between genders, boys with 2.65±1.21 of stress average and girls with 2.67±1.34. We **conclude** that the scale has shown good performance on its stability and reliability, and that the average stress is moderate in both genders.*

Keywords: *Stress pre-competitive; Young Athletes; Sport.*

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Introduction

The sport can lead decisive factors for the emergence of stress, since as a result to internal and external conditions that involve one person, several factors coming from the environment in which the individual belongs, may represent potential incentives that causes estresse[1]

De Rose Jr[2] says that the sport is a potential to cause stress if not appropriate and adapted to the needs and capabilities of practitioners. Santos et al.[3] argue that the most experienced athletes tend to demonstrate lower levels of stress pre-competitive, due to their greater experience in sports competitions.

The pre-competition stress on practicing school men's volleyball, aged between 15 and 17 appeared in the responses of athletes were the ones that provide high levels of anxiety, these symptoms are viewed as the factors that may interfere with the sporting performance of each young atletas[4].

Regardless of the outcome of the competitions, the stress should be a point of concern as to how it affects each individual is personalized, in other words, some athletes may experience higher stress compared to the others[5]. Moreover, as Myers[6] explained the adaptive response of the body to stress has three stages: the first one experiences an alarm reaction by activating the sympathetic nervous system; in the second phase, the resistance of the body is ready to counter the challenge. Persisting stress the body's reserves become deplete and cause the third stage, exhaustion.

Weinberg and Gould[7] describe the stress as a process containing four stages. First, the individual and placed a demand that can be physical or psychological, after the second stage is the perception regarding to the demand, which is different for each individual. Third step response occurs as demand lodged, and the last stage and the behavior of individual the stress caused by this process, so a continuous cycle especially when the answer is negative.

In addition, worth noting that the pre-competitive stress can cause consistent changes in the behavior of an athlete before competition, disfiguring his hours of sleep, and during sports practice, harm your desempenho[8].

Therefore, this study aims to identify the level pre-competitive stress for young athletes who participate in school sports competitions.

Materials and Methods

Sample and Place of Research

This study reinforced a descriptive research[9], and the sample established for convenience, with a total of 207 participants (n:207) of both genders, aged between 14-18 years (average of 15.89 ± 0.78 years, variation coefficient 4.90%); 85 was boys (average of 15.87 ± 0.86 years, variation coefficient 5.41%) and 122 was girls (average of 15.90 ± 0.72 years, variation coefficient 4.52%); all the sample attend the first, second and third year of high school in a Public School at Carapicuíba´s City - São Paulo, Capital - Brazil. The school sample was linked on the assumption established by Pasquali[10], stating that "are needed for sample 10 subjects for each item of the instrument; thus an instrument with 100 items would require 1000 subjects". The data collection procedure followed keep contact with the Director of the pertaining to school unit and the same was authorized data collection signing the commitment of the institution; then we, with the signing of the Consent Facility and Term of Consent by parents or guardians, since the participants were adolescents, thereby following all care research ethics it collecting data only meant to answer two instruments. The procedures for data collection followed the Newsletter to Research Subjects and signature of the Terms of Consent, by paying attention to research ethics set by the Declaration of Helsinki, 19649, Resolution no. 466, 2012.