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# GLOBAL AND STOCHASTIC ANALYSIS

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## MOTION ANALYSIS TECHNIQUES PENCAK SILAT MARTIAL ART WITH ETHNO-MATHEMATICS APPROACH

MANSUR, SISWANTOYO, IKHWANUDIN AND ALI BIN NADZALAN

**Abstract:** Pencak silat as a result of the people's thought process, which then developed for art performances accompanied by traditional music, and eventually developed into one of the sports competitions that were competed. For pencak silat achievement, it has developed quite well, but studies of various martial arts techniques used have not been fully explained scientifically. Besides this, pencak silat will also be explored with an ethno-mathematical approach. Starting from this, then through this research will be explored and analyzed by the martial arts movement through the approach of mechanics and ethno mathematics. This study uses descriptive quantitative and qualitative research approaches, samples used by male fighters, have won national and /or international events. Laboratory data were collected, as well as studies across ethno-mathematics disciplines. Furthermore, the data were analyzed with quantitative and qualitative descriptive analysis in accordance with the applicable procedures. The results of the study show that, Pencak silat is the result of the culture of the Indonesian nation which has a unique and multi-disciplinary knowledge. From pencak silat techniques can be revealed with a biomechanical analysis approach to effective and efficient. Besides this hall, the pencak silat engineers can also be studied with an ethno-mathematical approach. Basic movements of pencak silat with ethno mathematics approach found various patterns, symbols, and lines that varied, such as straight line patterns, curved lines, semicircles, triangles, rectangles, pentagons and others. With these results it will be more emphasized that pencak silat is a new alternative to science with an interdisciplinary approach.

### Preliminary

In accordance with the existence of pencak silat is one of the results of Indonesian culture. The development of martial arts at this time can be proven by the increasingly crowded events, ranging from elementary schools, teenagers, adults and even to multi-event sports at the Asian level and the invitations of world championships. In an international multi-event match, the overall champion of the Pencak Silat branch was held by another country, so it is enough to prove that the development has progressed well in Asia to Europe.

The basic techniques in pencak silat are: (1) defense, namely: blocking, avoiding, and deflecting, (2) attacks, namely: punches, kicks, falls, and locks, (3) lower techniques, namely: bottom sweep, lower circuit and cutouts (Agung Nugroho, 2004: 5). In order to be able to do the technique properly, good biomotor capability is needed. For this reason, the process of fostering martial arts must begin at an early age. However, there are also still people who are adults who have just started martial arts training. In practicing pencak silat various techniques are introduced by a trainer or teacher.

*Keywords:* motion, martial arts, mechanics, ethno-mathematics

Here the teacher or trainer must be creative and have a learning strategy in delivering pencak silat materials to students. The learning process occurs when the teacher or trainer sends messages to students. Here the role of correct motion engineering study is indispensable for the success of pencak silat learning. The learning method is adjusted to the level of age and skill level. In training for early childhood, Anggani Sudono (2000: 1) suggests that if the notion of play is understood and highly mastered, then that ability will have a positive impact on our way of helping the child's learning process. Mayke Sugianto (1995: 5) also points out that, from Froebel's experience as a teacher, he realized that playing activities enjoyed by children and toys that children like most can be used to attract attention and develop children's capacity and knowledge. Fun learning contains elements of play in the learning activities. The learning model is intended to provide convenience for students, so that a media that is fun and can be motivated by students is needed to help the process of delivering messages. The study of the movement of pencak silat techniques from the biomechanical aspect becomes very important at the beginner level, because the basis of the correct motion will provide ease in training. On the contrary, if the basis of motion and how to do it is not in accordance with the concept of biomechanics of motion, there will be many injuries.

This explorative descriptive study intends to reveal the pencak silat technique in terms of effectiveness and efficiency of motion from techniques carried out by a biomechanical approach to sports. Based on the description described above, the title of motion analysis of martial arts pencak silat with the biomechanical approach to sports can be taken.

Based on the problems outlined above, the formulation of the problem that can be proposed is as follows: How is the analysis of the movement of martial arts techniques with an ethno-mathematical approach?

This research aims to reveal the technical analysis of the movement of martial arts through an ethno-mathematical approach. These results will make it clear that with the correct motion of the technique, the effectiveness and efficiency of motion will be obtained so that it will improve performance. To reveal this, a motion analysis tool is used, by providing markers on the motion joints, and can be captured by the camera screen from four different angles. Next, it will be described from the tool in the form of biomechanical motion and supporting muscle contraction from each of the technical movements performed.

### Research Methods

This study uses a quantitative descriptive research approach, by taking a digital Motion Analysis Pro measurement, using a camera from 6 angles. The population used is Indonesian and Malaysian fighters, the sample used is selected by the criteria of male fighter, has been a champion in national and/or international events. Data was collected by tests and measurements, as well as analysis with motion pro. Furthermore, the data were analyzed with quantitative and qualitative descriptive analysis in accordance with the applicable procedures.



### Research Results and Discussion

This research begins with a series of previous processes consisting of preparation for data collection, searching for people to try, and describing the results. This study explains that the data collection process was carried out in two stages, the first by documenting with a set of video cameras, and the second by using a series of Biomechanics laboratory equipment at the Faculty of Biomechanics Lab, Sport Science and Training of Sultan Idris University of Education. A set of tools used is called vicom motion. To give an overview of a set of Vicom Motion Analysis tools, the following picture is presented.

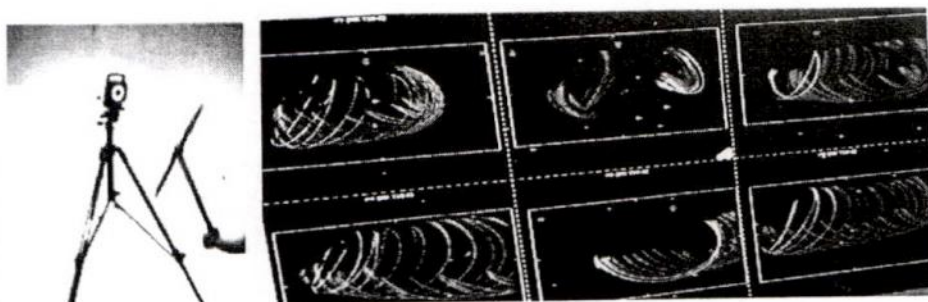


Figure 1: 6-point Vicom Motion analysis camera, and the results of checking checking conditions

On the computer screen shows that, the curved line that is green forming like a circle is the response of the camera sensor to the movement that will be carried out in an area force plate (the midpoint for the area to do the motion being tested). The following are the results of the research from the Biomechanics Laboratory as follows.

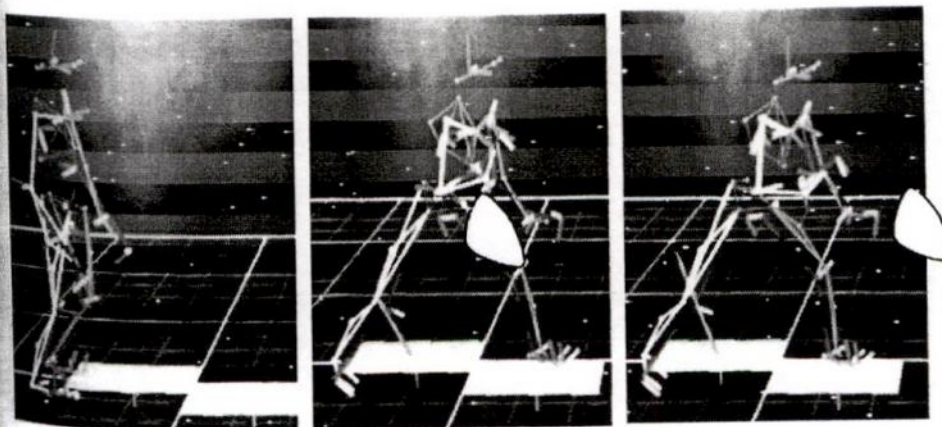


Figure 2: front tide attitude

Front tide attitude, is a prefix for athletes to initiate attacks in the form of punches and kicks. Body position is unstable, the front foot forms an angle and the weight is at the foot of the front so that it will make it easier to move. In biomechanics, the angle formed in the knee will help provide effective and efficient motion function.

### Attitude of Installing Rear Cross Legs

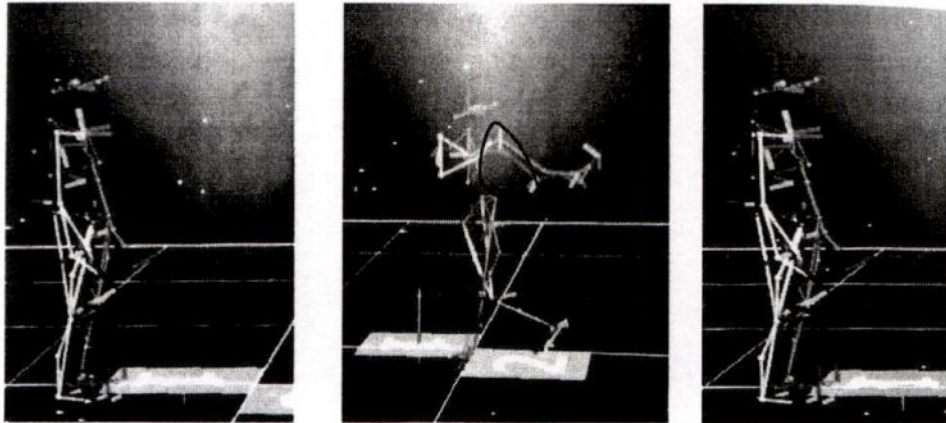


Figure 3: the attitude of the pairing of the rear cross

Attitude of the hind legs is done by stepping the foot past the back or crossing the legs. This attitude provides a basis for athletes to be able to kick T by jumping. This technique will get a range that is farther than the usual kick distance. In biomechanics, this kick technique has a shift in style by moving weight at a high speed. In line with the momentum theory, if a moving object with a higher weight and high speed, it will also get high momentum. Thus the implementation of the pencak silat match will get relatively higher kick power, so it's likely to get a bigger number.

### Attitude Riding the Right and Left Side

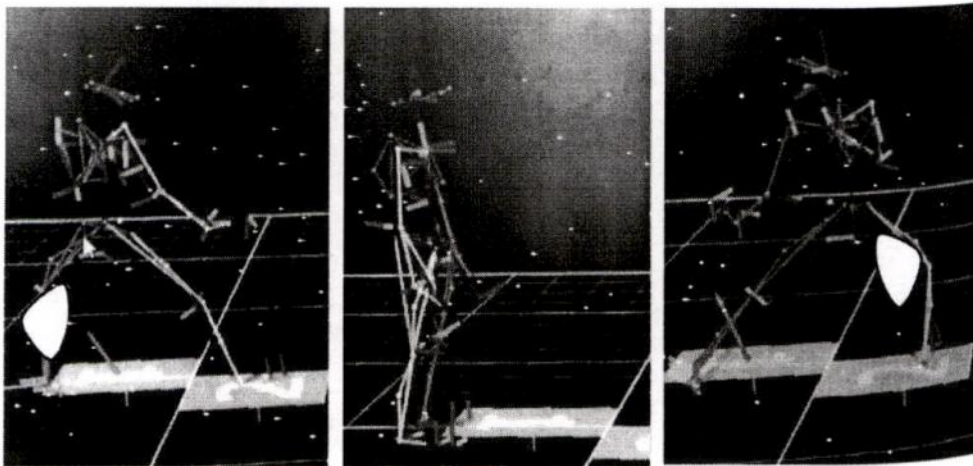
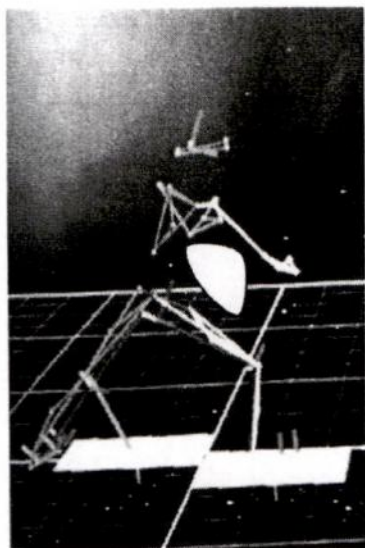


Figure 4: the attitude of attaching the right and left side style

The attitude of the horses to the right and to the left is aimed at preparing the athlete to be able to do the prefix to be able to carry on the advanced motion. This

movement is intended to initiate a kick or to survive by blocking an opponent's attack with a kick technique. Biomechanically, the weight is on the back leg, forming an angle. This technique is needed by athletes as a basis for attack and defense movements in matches.

#### Front Punch Technique



Picture: straight punch technique

Straight punch techniques can be done by hitting the arm directly, or starting with crossing the leg forward. This is done because of the distance of the range with the fickle opponent. The blow is done with a straight track and is assisted by the strength of the arm and shoulder muscles which eventually makes the punch stronger, faster and has higher power. Biomechanically, this movement, when viewed from a straight path, is assisted by quality muscle work, as well as an element of good physical ability, an effective and efficient work will be obtained. Straight punches in matches have the highest frequency of use compared to other types of blows. Besides the straight punch, there is also a swing punch, which is a blow by swinging the fist from the side by forming a semicircular line.

There is also a blow by swinging your fist downward with the chest target. According to Hui Zhi Zhang, (2015: 54) explained that in traditional methods of combat training, in the process of hitting, swing "quickly, accurately, and heavily" are the three most important factors: the speed and orbit of swing and the hitting position, real time speed of swing. The factors are determined that result in hitting effect. Excellence physical, reasonable swing action, hitting timing and accurate hitting position speed.

### **Ethno-Mathematical Approach**










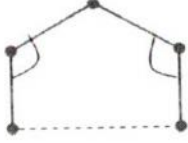
Ethno mathematics was introduced by D'Ambrosio, a Brazilian mathematician in 1977. The definition of ethno mathematics according to D'Ambrosio is: The prefix ethno is today accepted as a very broad reference to social culture context and therefore includes language, jargon, and codes of behavior, myths, and symbols. The derivation of mathematics is difficult, but it tends to mean to explain, to know, to understand, and to do activities such as ciphering, measuring, classifying, inferring, and modeling.








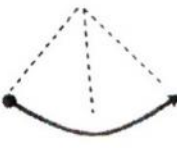
The suffix tics is derived from technology, and has the same root technique (Rosa & Orey 2011) In language, the prefix "ethno" is defined as something very broad that refers to the socio-cultural context, including language, jargon, code of behavior, myth and symbol. The basic word "mathema" tends to mean explaining, knowing, understanding, and carrying out activities such as coding, measuring, classifying, concluding, and modeling. The suffix "tics" comes from techne, and means the same as technique. Whereas in terms of ethnomatematics is defined as: "The mathematics which is practiced among identifiable cultural groups such as national-tribe societies, labor groups, children of certain age brackets and professional classes" (D'Ambrosio, 1985).

Based on the interdisciplinary approach, sports science can also be conducted with a mathematical approach. Mathematical modeling implemented in sports has begun. The following is one of the mathematical modeling in athletic sports, especially in javelin throwing numbers. According to J. Maryniak, and L. Kozdras, (2009) explained that the results of throwing in javelin depends on several factors, including strength, speed, physical and psychological preparation of the thrower. The technique of throwing, weather conditions when throwing, the type of javelin used, the field conditions also affect the results of the throw.

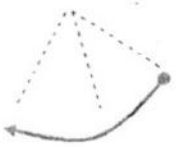





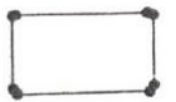

In the technique of pencak silat movement can be explained the existence of patterns that can study ethno-mathematics. This can be explained by symbols, as well as mathematical patterns in the form of straight lines, curves, circles, triangles, rectangles, and others. Visual symbols for various forms of physical education teaching and training in the use of the unified concept of the supply and development of the methods. Training of sport science means system is in line with the objective law. In the future, sport training will gradually increase the visual symbol application for promotion efforts and make it become the new teaching methods (Hong Gang Qu, 2015: 48). For more depth will be presented as follows.

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Technique	Picture	the ethno-mathematical approach with symbols, lines, etc.
Respect style		Straight line pattern 
Rear horses		Line patterns form angles 
Horses - side horses		straight line patterns and angle patterns 
Front horses		form a double angle pattern from both feet 
Middle tide attitude		pentagon pattern 

Technique	Picture	the ethno-mathematical approach with symbols, lines, etc.
Rear crossing attitude		<p>Form a cross pattern (X)</p> 
Front Post Attitude		<p>The position of the feet is a triangle pattern</p> 
Straight punch		<p>Form a straight line pattern on the arm</p> 
Swing punch		<p>Form a half circle / curved line pattern</p> 

From the above studies, a new understanding can be obtained, that Indonesian martial arts martial arts, it turns out to store basic mathematical knowledge that can be implemented in basic movements and matches. Basic movements of pencak silat with ethno mathematics approach found various patterns, symbols, and lines that varied, such as straight line patterns, curved lines, semicircles, triangles, rectangles, pentagons and others.

The ethno-mathematical approach with symbols, lines, etc	Picture	Technique
 <p>Forms a semi-circular path</p>		Cutting spiles in the hand
 <p>Form a double straight line pattern</p>		Double step in/out
 <p>Form a triangle footsteps pattern</p>		Triangle step
 <p>Form a rectangular pattern</p>		Rectangular step

### Conclusion

Pencak silat is the result of the culture of the Indonesian nation which has a unique and interdisciplinary knowledge. From pencak silat techniques can be revealed with a biomechanical analysis approach to effective and efficient. Besides this, the pencak silat engineers can also be studied with an ethno-mathematical approach. Basic movements of pencak silat with ethno mathematics approach found various patterns, symbols, and lines that varied, such as straight line patterns, curved lines, semicircles, triangles, rectangles, pentagons and others. With these results it will be more emphasized that pencak silat is a new alternative to science with an interdisciplinary approach.

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