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Motion Analysis of Kick Mechanism Using in Muay Thai Matial Art

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Abstract. The purposes of this research were to analyse speed of basic Muay Thai skills which consists of using feet and knee. By using the human motion-tracking cameras to create 3D animations that is associated with an image from a video camera and biomechanics analysis. The subjects group consisted of 5 professional boxers from Kiat Moo 9 Muay Thai camp by using purposive sampling method. The instrument used of this research was Qualisys Trach Managa (Motion Capture System). It was used to collect data motion capture and to analyses velocity Muay Thai basic skills. Statistics used for this research were arithmetic mean and standard deviation. The results showed that the average speed of basic Muay Thai skills include, Diagonal Kick, Straight Foot-thrust, Sideways Foot-thrust, Straight Knee-kick and Diagonal Knee-kick has 17.15, 6.01, 5.28 6.29 and 6.42 m/s, respectively. Standard deviation has 2.90, 1.47, 1.24, 1.01 and 1.75 respectively.

1. Introduction

Muay Thai, also known as Thai boxing, is a martial art that gradually developed over many centuries. Muay Thai was originally trained in to assert oneself in real fight situations. In the course of time Muay Thai also became popular as a competitive sport at fairs, which both gave athletes the opportunity to test their skills and provided entertainment for the audience. [1] Today, Muay Thai is practiced as a competitive sport, for fitness, and for self-defense. Muay Thai competitions are a spectacular sight and are extremely intensive. Fighters attack each other to full physical exhaustion with fists, elbows, kicking, and knee techniques. [2] Thai boxers generally have had excellent technical training, and their bodies have been trained to become muscular, high performance instruments.

However, Muay Thai training must understand and practice basic skills such as the use of foot, knee and elbow. [2] The basic training Muay Thai boxing to teachers to begin from the basic posture training is taking boxing stance positioning organs and the fist foot. Knee and elbow etc. and must practice regularly but the present teacher skilled boxer boxing training can be difficult.

For this reason, the application of sports science and sports science knowledge to the conservation and development of the fundamental Muay Thai is important so also must have a method to seek the facts or findings as the new information that will lead to the development of national sport even more. The studies and boxing skills by recording motion capture image. But it cannot be analyzed body

movements or the movement of the comparison with master trainers to use in training athletes in Thai boxing.

Therefore, the study and analysis of motion of a body's components in designing the basic skills in Thai boxing will help see the movement. [3-4] Each step carefully and clearly such as time, speed, acceleration and angle of movement [5-6], which is a component of the basic skills in Thai boxing will make people interested to get into the study and understanding of the movement. In addition, it can be used as a baseline in the design of teacher training student Thai boxing. Students and the general public, which is considered a conservation culture of Thailand.

2. Theory

2.1. Basic Muay Thai skill

In Muay Thai, leg work training is an important skill because the leg is a powerful organ for fighting and able to use at a distance. The leg work of Muay Thai defines from below the knee to the toes. The powerful stances of leg work are knee kick and the Foot trust. The Knee kick which the spinning body into the knee creating a devastating impact to the opponent, for example, the straight knee kick, the diagonal knee kick, etc. The foot trust which the method of bend at the knee, then quickly extending your leg to use foot or heel to attack the target, for example, Straight Foot thrust, Sideways Foot thrust, etc.

2.1.1. The Diagonal Kick. Figure 1 has shown the Diagonal kick post of the boxers. The boxer put his body-weight on his left leg and twisting his right hip then raise his right leg, bent at left. The lower leg is therefore at an approximate 45° angle, the shin and the toes being in a continuous straight line.

Finally, lash your lower right leg diagonally upwards from right to left against the target.

Figure 1. The diagonal kick. [7]

2.1.2. The Straight Knee – Kick. Lean forwards, transferring the body-weight to the left foot and firmly grasp the opponent's neck with both hands as shown in Figure 2.

With a twist of the right hip over left for extra force, thrust your right knee up against the target, the toes of your right foot pointing directly downwards to the floor, while simultaneously pulling down on your opponent's neck. (When adopting this method, your body will naturally lean slightly backwards, with the heel of your left foot raised off the ground).

2.1.3. The Diagonal Knee – Kick. Lean forwards, transferring the body-weight to the left foot and firmly grasp the opponent's neck with both hands.

Thrust your right knee diagonally upwards at an angle of approximately 45° from right to left, the toes of this foot straight down. Simultaneously, pull diagonally downwards from left to right on the

opponent's neck, bracing your left foot against the floor as shown in Figure 3. Impact your knee-cap forcefully against the target.

Figure 2. The Straight Knee-Kick [7]   **Figure 3.** The Diagonal Knee-Kick [7]

2.1.4. The Straight Foot – Thrust. Put the body-weight on the left-leg and raise the right leg, the knee bent at a 90° angle, the toes pointing forwards as shown in Figure 4.
Twisting your right hip and thrusting your right leg straight.

       a. your toes tightly pressed together

       b. the ball of your foot, fully exposed by straining your toes

       c. the sole of your foot

       d. your heel to impact against the target

2.1.5. The Sideways Foot – Thrust. Pivot to the left on the left foot, while bringing the right hip round to the front (Figure 5). At the same time, pull your right leg, knee tightly bent, up and into your body, learning back and over to the left. Your right shoulder, hip and heel are thus in a straight diagonal line pointing to the target.
Thrust your right forwards so that the sole of the foot impact against the target.

Figure 4. The Straight Foot-Thrust [7]   **Figure 5.** The Sideway Foot-Thrust [7]

2.2. Motion Tracking Technology
Motion Tracking is important in research at present. Especially used to study and analyse the movement in athletic training. The motion tracking using the science of mechanics and techniques of using image such as [4] Motion-tracking cameras to study the movement of the human body by 3D simulation of motion of the arms and upper body, which can create an animation corresponding to the video. [3] In addition, modelling and tracking human motion by Function Analysis by building a statistical model for the movement of human activity. Consider that the human body consists of a

series of articulated cylinders and joint effects of tracking Algorithm can track the movement of the video as well. [4] For the presentation of a multiple hypothesis tracking which is classical approach by which the hypothesis is generated from the information that there is a relationship between a series of measurements and features target. [5]

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3. Methodology

In the research process to analyse the biomechanical basic skill Muay Thai by using Model-Based Approach [8-9]. The detailed research steps as follows.

Analysis of the movement of Muay Thai by using purposive sampling method of 5 professional boxers from Kiat Moo 9 Muaythai camp at Burirum province. The basic skills of Muay Thai for analysis which consists of Diagonal kick, Straight Foot-thrust, Sideways Foot-thrust, Straight Knee-kick and Diagonal Knee-kick. The instrument used of this research was Qualisys Track Manager (Motion Capture System) made in Sweden. It was used to collect data motion capture and analyze speed Muay Thai basic skills. The figure 6 and 7 show the Mark position on the boxer body on the front and back view and the detail of each mark appear in the Table 1. Statistics used for this research were arithmetic mean, standard deviation, maximum and minimum.
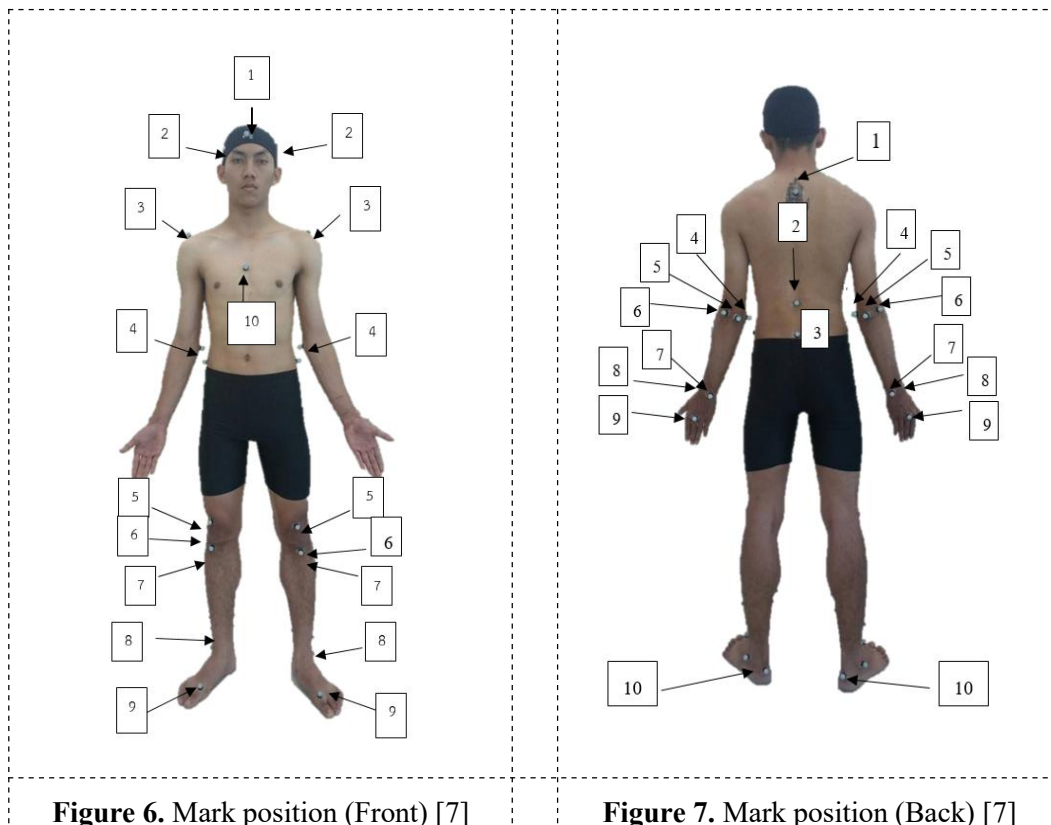

Figure 6. Mark position (Front) [7]   **Figure 7.** Mark position (Back) [7]

4. Results

Biomechanical Analysis of the Muay Thai skills of 5 professional boxers by considering the statistics of basic skills, including, Diagonal Kick (DK), Straight Knee-kick (SKK), Diagonal Knee-kick (DKK), Straight Foot-thrust (STFT) and Sideways Foot-thrust (SIFT) are shown in Table 2 and Figure 8-9.

Table 1. Details of the marker position (Front and Back).

	Abbreviation	Position (Front)	Abbreviation	Position (Back)
1	CFB	Center of Frontal Bone	C2	Cervical 2
2	RTPB, LTPB	Right and Left Parietal Bone	T12	Thoracic 12
3	RTAB, LTAB	Right and Left Acromion Bone	CSB	Center of Sacrum Bone
4	RTICB, LTLCB	Right and Left Iliac Crest Bone	RTCF, LTCF (Elbow)	Right and Left Coronoid Fossa
5	RTLCL, LTLCL	Right and Left Lateral Cartilage Ligament	RTME, LTME	Right and Left Medial Epicondyle
6	RTCPB, LTCPB	Right and Left Center of Patella Bone	RTLE, LTLE	Right and Left Lateral Epicondyle
7	RTHTB, LTHTB	Right and Left Head Tibia Bone	RTUB, LTUB(Insertion)	Right and Left Ulna Bone
8	RTTB, LTTB	Right and Left of Talus Bone	RTRB, LTRB (Insertion)	Right and Left Radial Bone
9	RTMTB, LTMTB	Right and Left Metatarsal Bone	RTLB, LTLB (Wrist)	Right and Left Lunate Bone
10	STB	Sternum Bone	RTCCB, LTCCB	Right and Left of Calcaneus Bone

Table 2. Statistical analysis of Muay Thai skill

Muay Thai skills	$\bar{X}$	SD	MAX	MIN
Diagonal Kick	17.15	2.90	21.03	13.58
Straight Knee-kick	6.29	1.01	7.95	6.18
Diagonal Knee-kick	6.42	1.75	8.68	3.87
Straight Foot-thrust	6.01	1.47	7.93	4.38
Sideways Foot-thrust	5.28	1.24	7.26	4.34

Figure 8. Average speed of Muay Thia Skills.

Figure 9. Maximum and minimum speed of Muay Thai skills
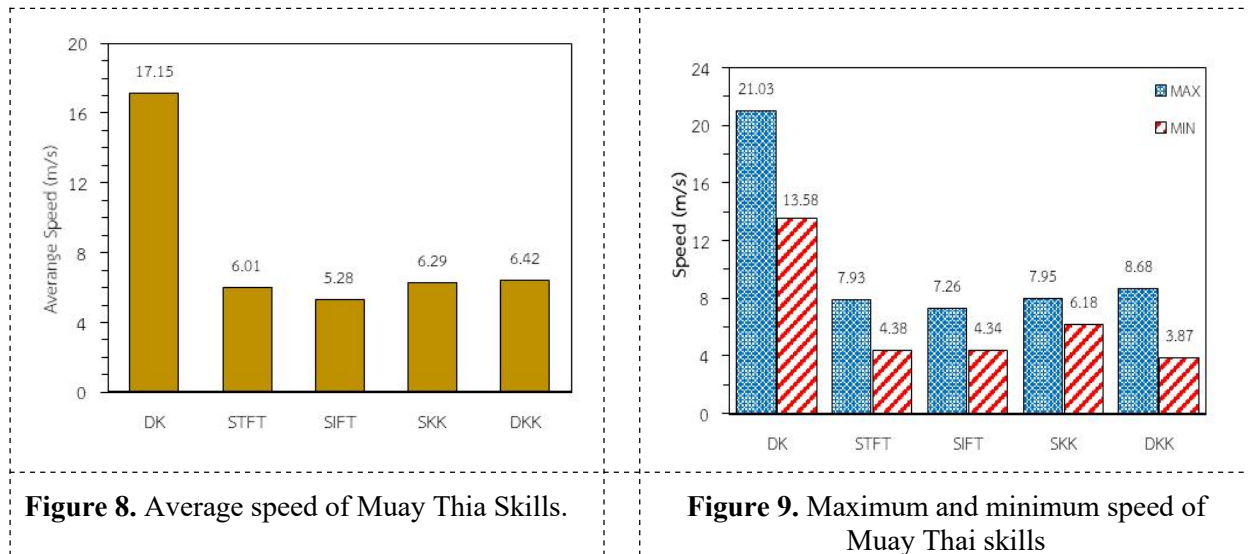
5. Conclusion

The Speed analysis by using Motion tracking technique of Muay Thai skills of 5 professional boxer reveals the target strength for novice athlete. The average speed of each Muay Thai trances in this study are 17.15, 6.29, 6.42, 6.01 and 5.28 m/s for Diagonal Kick, Straight Knee Kick, Diagonal Knee Kick, Straight Foot Kick and Sideways Foot Kick, respectively. The finding that Diagonal Kick could make the most impact to the opponent among legwork trances because of the highest speed. The future work of this study could explore the Thai boxing training program for the athlete by using speed data of the Muay Thai trances of professional boxers along with their physical fitness such as grip strength, flexibility, lung capacities, Leg strength, etc. The program expects to enhance the athlete's physical fitness close to the professional boxer. The biomechanical analysis of athletes using the Motion tracking technology could be applied to ensure the success of the program compares to the data of professional boxers.

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