

Sinewave in ITF Taekwon-Do

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In the martial arts since wave is viewed as one of the defining aspect of ITF Taekwon-Do, but what is sine wave? In pure terms sine wave is a mathematical curve that describes a smooth repetitive oscillation, which has a constant amplitude and wave length. In the natural walking gait of human's the centre of mass follows a curved path (Cross, 1999), similar to a sine wave, and when running the legs behave like springs. These concepts look to be the origin of the term sine wave as applied to Taekwon-Do movements as envisioned by Gen Choi (1999). It is interesting to see that it is included in two of the training secrets, first: to study the theory of power thoroughly; and second: to create sine wave by utilising the knee spring properly.

What is the purpose of sine wave? The theory of Taekwon-Do tells us that the purpose of sine wave is to increase the amount of force delivered by a technique. The theory of power for Taekwon-Do has several elements; one of these elements is mass (Choi, 1999). The concept of this element is to maximise the utilisation of a practitioners mass to generate as much impact force, generally referred to as power, as possible. Under this element there are two methods outlined to help a practitioner increase their power, through increasing their weight while performing a technique. While the mass of a practitioner will remain the same throughout their technique, if their mass is accelerated, for example with gravity, then their weight is increased, as shown by the scientific formula of $\text{force} = \text{mass} \times \text{acceleration}$.

The two methods of increasing the weight applied to a technique, increase force, both centre on the acceleration of the large muscles in the hip. The two methods are: to move the hip sharply in the direction of the technique, often called hip twist; and to raise the hip at the beginning of a movement and lowering the hip sharply at the moment of impact by using a springing action of the knee, called sine wave. When in a stationary position utilising hip twist adds weight to a technique in the horizontal plane, while utilising sine wave adds weight to a technique in the vertical plane. However when moving or stepping forward, hip twist continues to add weight in the horizontal plane, while sine wave mainly adds weight to the vertical plane it will also contribute the weight in the horizontal planes.

So how is sine wave performed in Taekwon-Do to increase power? Gen Choi (1999) only provides a small amount of practical information on how to perform sine wave, primarily when forward stepping. The concept is to incorporate the natural curved path of the centre of gravity when walking into Taekwon-Do movements when moving. As discussed above the desired outcome from performing sine wave is to increase weight applied to a technique, by dropping at the moment of impact. To achieve this effect the body's mass needs to be lifted up so that it can be dropped. When a Taekwon-Do practitioner moves from one stance to another, the sine wave motion is created by relaxing and using the motion of the body to compress the knee of the stationary leg, and then this compression is released by lifting the body, enabling it to be dropped. This normal sine wave is described as having three parts, commonly referred to as down-up-down.

It is a common error where a practitioner focuses on lifting the body in order to drop their mass and increase their weight, missing out the initial downward movement. This results in producing an unnatural body movement that is referred to as a saw tooth motion. The main reason that the saw tooth motion is considered an error is, while this motion does lift the body's mass, due to the unnatural motion it creates balance is not maintained and the speed the body moves at is reduced, which reduces force. The reason for the downwards movement of the body at the beginning of a movement is both to assist relaxation of the body, so that can increase the speed at the end of the

movement, and also to enable lifting the body with knee spring action easier. Another common mistake when performing sine wave is to overemphasise the initial downward motion, this overloads the muscles of the stationary leg and as a result makes lifting the body more difficult. While the initial downward motion of sine wave is important, it should only be performed to the extent that it makes the upward motion more efficient to perform.

Looking at different ways that sine wave is performed during different motions shows some further concepts for utilising mass to generate additional weight applied to movements. There are several different motions in Taekwon-Do: normal, slow, continuous, connecting, and fast motions, with sine wave applied slightly differently to each motion. During normal motion the sine wave is performed as described above, with the normal down-up-down sine wave, and slow motion is a normal motion technique slowed down with no change to the sine wave. Continuous motion is when two or more techniques are performed, usually without stepping, without a pause between the movements. When continuous motion is performed there are two sine waves performed: one with each movement. Connecting motion is when two movements are performed with only one sine wave. The first technique is performed during the upwards portion of the sine wave, utilising the knee spring which is accelerating the body mass in an upwards direction to add force to a movement that is also moving upwards, and the second technique is performed on the downwards movement of the sine wave. This motion is mainly utilised when performing a scooping block followed by an attack. This brings the concept that the knee spring can be utilised to add force to a movement directly when moving upwards, in addition to utilising the dropping of the mass. This concept can also be found occasionally in Taekwon-Do, such as when performing a scooping block on its own in normal motion as in Choong-Jang, and when performing a high front strike while standing up in Ul-Ji.

Fast motion is a term used for the motion for two techniques, where the first movement is performed normally, and the second movement is performed with only the up-down part of the sine wave, sometimes called two-thirds sine wave. As discussed the reason for the first down movement in sine wave is enable the knee spring to allow lifting the body's mass more easily. In fast motion the second movement is performed immediately on completion of the first movement. When performing a fast motion sine wave the momentum generated when dropping the body's mass at the end of the first movement can be utilised to lift the body's mass on the second movement easily, therefore removing the need to compress the knee a second time. This motion introduces to the Taekwon-Do practitioner to a new way of redirecting their body's momentum to increase the weight applied to a second technique executed in conjunction with another movement, as is more likely to be the case when Taekwon-Do is used in sparring or self-defence.

Does sine wave increase the amount of power of a given technique? It can be seen that when the dropping of the mass with gravity towards the ground does increase weight in the vertical plane. Therefore a technique that is travelling downwards will easily benefit directly from a sine wave, such as a downwards punch or downwards block. However a technique that is moving in the horizontal plane, such as a middle punch, is moving perpendicular to the direction of the movement of the mass created by sine wave, and it would appear to contradict the principals of physics to see a direct increase in power from dropping body weight with gravity in the vertical plane. However another element of the theory of power is equilibrium. A heavier object will require more force in order to move it, which is described in physics as accelerating its movement. Taking this concept into account the dropping of the body's mass with gravity will increase the weight of the practitioner moving into the ground, increasing their stability, or equilibrium. If the timing of the sine wave is performed so that the punch reaches the target at the same moment the weight on the ground is the greatest, then the amount of momentum in the punch able to be transferred to the target will be increased. However if there was enough stability provided from a stance without sine wave then

all the momentum generated may be able to be transferred without generating additional weight. As the third training secret of Taekwon-Do is: “to bring the co-ordination of the hands, feet, eyes and breath into a single co-ordinated action”, then it can be seen that the intent is for the sine wave to finish at the same moment as the technique. In addition the sine wave can be used as a physical cue as part of the mnemonic of how to move, to co-ordinate the movement of the different parts of the body with the breath through relaxation, increasing equilibrium and speed; bringing everything into a single co-ordinated action.

The theory of sine wave has been incorporated into individual Taekwon-Do movements, patterns and step sparring, but can it be applied in free-sparring and self-defence? There is plenty of disagreement on the usefulness of sine wave when applied to sparring and self-defence. There is generally no sine wave demonstrated during Taekwon-Do free sparring. This could be due to free sparring requiring the delivery of techniques at high speed and taking additional time to incorporate a sine wave into sparring would render techniques ineffective due to the increased time they take to perform, and can also telegraph the technique, allowing the opponent to block or avoid them. The additional time required to incorporate a sine wave into a technique during sparring or a real self-defence situation does make this theoretical idea look impractical and results in a negative view of the sine wave theory by other martial arts practitioners (Djurdjevic, 2009). However utilising the mass of the body during self-defence can be effective, incorporating a technique such as an upward punch into the upward part of a sine wave, and following on with a downward moving technique while moving the body weight down onto the opponent. Additionally the added stability that can be generated by dropping the body’s mass into a stance while being pushed by an assailant can substantially increase stability and allow greater transfer of momentum to the opponent with a technique moving in the opposite direction to the push.

While the jury appears to still be out on the effectiveness of sine wave it can be viewed that sine wave does not necessarily add force to a technique by itself. However when sine wave is incorporated with the other elements of the theory of power, and training secrets of Taekwon-Do it can facilitate the delivery of a more forceful technique.

References

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