Jukido Jujutsu Stances: The Path to Balance & Power

"Bend your knees," "back straight," "hips underneath you" are all sayings one might hear on a typical night in the dojo. As jukidoka, have we ever stopped to understand the meaning or underlying reasoning for why these sayings are repeated so often, or do we accept that these are mantras that are to be heard but not followed? All of these sayings deal with the stance one is taking while performing a technique, and all sayings are indicative of a poor stance. A stance is like the foundation of a building, and if there is a weak foundation then the building is likely to collapse or may not function as desired. Similarly, having a poor stance can lead to a total collapse of the body, ineffective techniques or even injury to oneself. Hence, the art of the stance is the path to balance and power within one's techniques.

What is a stance? This seemingly simple question is actually quite complex. On one end of the spectrum, we could say that a stance is a way of standing, but this would be far too broad and would encompass positions where one is partially off-balanced. On the other end, we could say that stances are very specific and list them out like many martial art resources do: rooted stance (fudo dachi), backwards yielding stance (kokutsu dachi), one legged stance (gankaku dachi), half moon stance (hangetsu dachi), cross stance (kake dachi), horse riding stance (kiba dachi), attention stance (musubi dachi), cat foot stance (neko-ashi dachi), hourglass stance (sanchin dachi), straddle leg stance (shiko dachi), shoulder drop stance (seoi-otoshi dachi), crane foot stance (tsuru-ashi dachi) or forward leaning stance (zenkutsu dachi). However, this would miss out on stances that exist but may not have been specifically named or even mentioned for sake of brevity or ease of understanding. For example, body drop stance (tai-otoshi dachi), or the stance one takes when performing a hip throw like ogoshi, could be considered stances even though they may not typically be referred to as such.   This is because many stances derive from a karate background and are typically used to perform a strike. However, in jukido jujutsu, stances can be used in a larger variety of ways, as the art encompasses not only striking, but also throws, grappling and choking techniques. Hence, a definition that would fit this way of thinking is: "a stance is a moment in time within which the body is standing, aligned and weighted to either receive or transmit energy utilizing the entire body."

Stances are used widely within the art, and one only need to look at some of the basic white belt curriculum to see this. For example, the "mugger's hold" attack is composed of two stances: seoi otoshi dachi and zenkutsu dachi. In this application, the seoi otoshi is used to begin the off-balancing of the attacker while rooting the defender low to the ground on the rear foot while simultaneously applying pressure to the attacker's leg. The transition from the seoi otoshi dachi into the zenkutsu dachi is ultimately the driving force that leads into a strong bow which brings the attacker down. A simpler example of an attack that utilizes a strong stance is the "rear underarm bear hug." The defense for this attack consists of quickly lowering oneself into a low kiba dachi such that the attackers knee is locked out, so that when the defender pulls out their heel, the attacker easily falls down behind the defender. A final example would be the "rear choke" where the defender utilizes a kake dachi followed by a sharp pivot into a fudo dachi. This changeover breaks the attacker's grip and allows the defender to follow up with a shuto to the ribs. As has been shown, stances are not only a core aspect of self defense, but the transition between stances is also important to effectively utilize stances in real self defense applications.

Stances are an important aspect of jukido jujutsu, because they provide a conduit through which energy can be transferred. To maximize that transfer of energy, we can examine a well known mathematical equation. The equation is: kinetic energy equals one-half mass times velocity squared (KE = $\frac{1}{2}mv^2$). This equation implies that the more velocity that we can achieve through our stances, the more energy we will be able to output at the end of our technique, such as for a strike or a throw. A proper stance roots motion with the ground and applies the largest number of muscles which allows the body to accelerate to the maximum velocity before impact occurs. The equation also shows that while mass is an important factor in generating energy, velocity has twice the impact, so this is part of how

jukido jujutsu techniques can generate more energy or power than an untrained attacker who may be bigger and stronger. Thus, to maximize the amount of power that can be harnessed from a stance, one must ensure that the entire body can be utilized throughout the full motion of a technique.

Another important aspect of stances is alignment. If one has a perfect stance, but an attacker is approaching against the stance's weak line then the stance will not hold up or will be ineffective against the incoming force. A stance is like a sword; one would want to align the sword such that the sharp edge (the strong line) is facing the attacker. If a sword is angled such that the flat side (the weak line) is aimed at the attacker, then the amount of damage that will be inflicted will be minimal in comparison to the sharp side. As an example, if an attacker is trying to push from directly in front and the defender drops into a kiba dachi facing the attacker, then it is likely that the defender would fall over, because the alignment for that particular stance does not match the incoming attack. Instead, the defender should rotate ninety degrees and orient the kiba so that one shoulder is facing the attacker. In this way, the strong line of the kiba can be utilized to thwart the incoming attack. Hence, like a sword, a stance must be aligned properly to gain the optimum benefit.

Teaching jukido jujutsu is a complex task, as it requires being able to translate what is ultimately a holistic physical language into a set of small incremental improvements that can be learned in bite-sized pieces. This is even more true for computers, which lack all understanding of the physical world and the references that it provides. Nonetheless, computers can learn about our world through abstractions. One such abstraction that has been made commonplace in the artificial intelligence space is the ability to effectively compute three dimensional coordinates of a person's pose within a picture. The coordinates include the following key locations: the nose, three points for each eye (left, middle, right), each ear, two points for the mouth (left, right), each shoulder, each elbow, each wrist, three points for each hand (thumb, pinky, index fingers), each hip, each knee, each ankle, each heel and each index toe. Using these coordinates, a neural network and a lot of supervised training, it is possible to teach computers how to recognize poses. The poses that we have attempted to teach the computer are those of the stances in jukido jujutsu.

The process for teaching the computer the stances involves multiple steps. The first is to obtain many videos of a single person standing in the various stances from a variety of angles. The second step is to take the videos and splice them into individual images so that the third step can be completed by taking the individual images and generating the coordinates described earlier. The fourth step is to take the coordinates and train a neural network to find commonalities in the categories. The final step is to take the trained network and use it within the application to make predictions. The application is set up to read the user's camera and then generate the same coordinates which were given to the trained network. The network provides an output representing one of the stances.

This initial model worked relatively well at first, but there were some clear issues. One of the first issues noticed was that the model gave predictions even if the user was clearly not standing in one of the defined stances. The 'unknown' category is a common problem to have with this type of model and in some spaces, it can be solved by teaching the computer what the unknown category is by providing examples of all possible unknowns. However, this approach is not practical in a jukido jujutsu stance application, because there are far too many possible wrong configurations to possibly obtain them all, so another approach is required. To solve this, another model was trained that would classify a stance as either that stance or not that stance, so for example, if the model was for the stance kiba, then we would provide it all the images that contain people who are standing in that stance as the correct stance, and all the images of the other stances would be classified as the incorrect stance, or 'not kiba'. This produces a binary model for each stance that can more accurately predict whether the user is in one of the classified stances at all. When we receive coordinates from our application we can use them not only in the initial model, but also within each binary model to tell us both the initial category that it believes the stance is along with a list of other stances that it could be. When the initial model matches with the binary models such that only one binary model provides a positive output, and that

matches exactly to the initial model, then we consider that as a positive identification for that stance. If the binary models produce more than one stance as positive, then we consider that as an ambiguous result, as the user may be standing in some fashion that is in-between two different stances. Only when none of the binary models produce a positive output do we consider the stance as unknown.

Another issue that arose was that the model often divided the categories purely based on the location of the hands or upper body, such that if the user of the application waived their arms around, then the predicted stance would change. The stances that make up the curriculum are primarily defined by the location of the lower body, and the upper body will change based on how the stance is being utilized. Hence, to eliminate this issue, all of the upper body coordinates were thrown away so that the model could only divide the categories based on the lower body. This left the following ten points: each hip, each knee, each ankle, each heel and each index toe. With this change, a new issue came about, in that the lesser number of points didn't leave much room for the computer to understand the difference between some of the stances. Take, for example, kiba and shiko. These two stances differ only by the orientation of the feet: kiba is facing forward and shiko is angled outward, which is a very subtle difference. Another example of this is sanchin and fudo. These two stances have a few extra differences, such as there being a lead foot in sanchin versus no lead foot in fudo, and the angle of feet in sanchin is slightly inward, whereas fudo has feet facing outward, similar to kiba. These differences may be easy to spot to a person who can move around within the three-dimensional space to see the full picture; however, when looking at the stances as singular still images, distinguishing the stances becomes quite difficult from certain angles.

On the way to becoming a master, it helps to look at things from new perspectives. The stance application takes a new look on stances by teaching a computer how to recognize them. While the application may not be perfect, it is a good start in providing a computer with a glimpse into the world of jukido jujutsu. New perspectives provide new obstacles that must be overcome, such as the issues that were described. As obstacles appear, if we persevere through them, then we will always come out ahead with new knowledge. In effect, the obstacles become the way in which we continue to perfect our knowledge, whether that is for stances or anything else that we may seek to master.

Stances are often under-appreciated and neglected, as they are merely the supporting structure. As few people go into a beautiful architectural building solely to inspect the foundation, few people go out of their way to look deeply into the stances that support all of the techniques that are utilized in jukido jujutsu. Stances are an integral aspect of techniques, as they provide a balanced way of transferring energy. In real self defense applications, the transition between stances is critical to effectively utilizing them. To maximize the amount of power that can be harnessed from a stance, one must ensure that the entire body can be utilized throughout the full motion of a technique. A stance should be angled like a sword so that the strong line is facing the attacker. One must continuously look at knowledge through the lens of new perspectives to obtain new insights that grow the understanding of that knowledge to become a master. Therefore, to obtain maximum balance and power in a technique, one must master the art of the stance.

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