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The Art of Balance: Exploring Analogies in Taiji Forms and Tensegrity Structures

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Abstract — This essay explores the analogies between Tensegrity and Taiji (which is the common abbreviated English name for T'ai Chi Chuan). Tensegrity is a structural principle that employs tension and compression to create a self-supporting structure, and this investigation focuses on how characteristics of Tensegrity, such as discontinuous force distribution, or the maintenance of self-equilibrium, relate to the movements and philosophy of Taiji. Drawing on selected core Taiji principles, this study examines the properties and behavior of self-constructed Tensegrity models and their relevance for Taiji practice. The analysis also aims to provide some insights into the parallels between tensegrity structures, natural systems, and human biomechanics, through emphasizing the role of soft, non-linear systems.

Ultimately, this overview highlights the shared principles of harmony and efficiency in Taiji and Tensegrity, and offers some new perspectives on the interactions between physical movement and structural dynamics.

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1. Introduction

> "There's a thing that we call 'tensegrity' where you have all the different tensions in the muscles balanced in a particular way that align the skeleton and allow the bones to float in space, essentially."

This quote was taken from Ian Sinclair's video The Magic of Alignment in Taiji[1] and it marked the beginning of my Project in Norway under Pamela Hiley in 2022/23

The aim of this paper is to explore conceptually the connection between Taiji and the structural principle called Tensegrity. Tensegrity, is where a three-dimensional stable structure is constructed from rigid inflexible members and soft flexible wires, due to an internal balance between compression and tension.

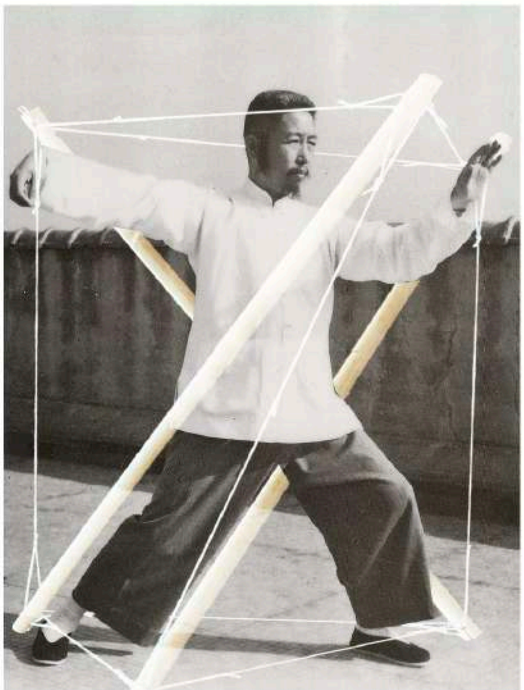

Fig. 1. Cheng Man-Ching practicing Taiji in 1922 (Source: Wikimedia Commons), Photo montage with a 3-struts Tensegrity model by the author)

Recently, in architecture the use of tensegrity has became popular, as structures based on tensional integrity create open, light forms

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that sometimes appear to defy logic. Research into these structures is now extensive[2-4], and the latest structures are no longer structural curiosities, and are being used in robotics and infrastructure projects, such as the Kurilpa Bridge in Australia and the Kenneth Snelson's Needle Tower art sculpture, which are self supporting through a careful balance between tensional and compressional forces.

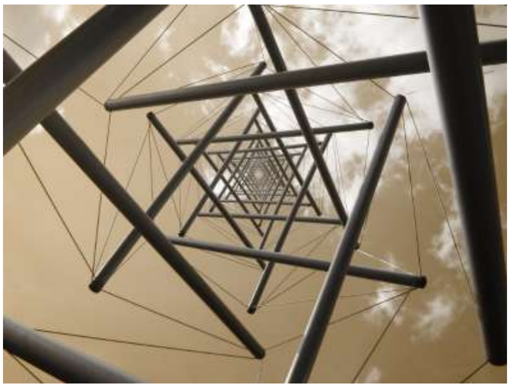

Figure 2: Kenneth Snelson's Needle Tower art sculpture; Source Onderwijsgek, Copyright, CC BY-SA 2.5 nl

At the simplest level, tensegrity describes structures where the shape of the structure is held together by a network that creates continuous tension, where the key principle is separating the compression and tension components, so that elements in tension only experience tension, and there are no shear or compression forces; and the elements in compression only experience compression forces, again with no shear or tension forces. Thus, true tensegrity structures, such as the Buckminster Ball, which was created by R. Buckminster Fuller[5], in the late 1950s, are entirely linear in structure, and they cannot contain any curved lines.

Because nature likes to adopt energy efficient structures, it would not be surprising to see tensegrity inside the human body[6], and some overlap can indeed be seen, with the bones in the body being the element under compression, and the muscles, tendons and ligaments operate under tension. These structures are both stable and lightweight, and the minimal amount of material to achieve their purpose.

Today there now seems to be countless articles on the internet that review tensegrity or biotensegrity structures. Some models are simple and others more complex, but they all shared a certain natural aesthetic. A good visual overview that explains the physics behind these structures is provided by Steve Mould[7] and in text form in ResearchGate[8].

It could be said that tensegrity structures express internal forces in their purest form. However, the purpose of this study is not to replicate force vectors in the body by relating them to external 3D structures. That, clearly, is impossible as the forces in tensegrity differ substantially from those created in Taiji. Instead it is to determine if the shapes created by a Taiji practitioner can be recreated using self-supporting Tensegrity structures and if they can be used to gain insight into the movements enacted in Taiji; and could these artistic sculptures perhaps influence Taiji training, for us in competitions?

Here the answer to the second question is yes, with the generated images being so intriguing, they could easily be placed in any modern art museum, and it could also be argued that science, or to be more accurate structural principles are being used to create art, where the frame itself is the art piece.

Figure 3: Drawing of martial artist in the 'Snake Creeps Down' posture; modified and photo montage by the author.

However, the first question is much more difficult. This revolves around the question of whether tensegrity structures can routinely replicate not just the shapes made by Taiji movements, but also the thought process used in creating Taiji movements.

Tensegrity can often be difficult to grasp, and even images or illustrations may not always fully explain it. Thus, video links are provided at the end of the relevant sections in an attempt to better illustrate the studies.

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Tensegrity is based on one principle and that is to use a balance between tension and compression to create stable structures. It was first described scientifically by architect R. Buckminster Fuller[5] in the late 1950s, and first visualized by sculptors Karlis Johansons in 1921, Kenneth Snelson in the 1950s, and the French architect David G. Emmerich who also lived in the 1950s.

In contrast, though some recent studies are beginning to study the forces involved in Taiji in a more scientific manner[9,10], Taiji is mainly studied as an ancient Chinese martial art for improving health, strengthening the muscles, improving psychological wellness and using it for general self-defense.

The knowledge of Taiji has primarily been passed down to us through a history of oral tradition, practical training, and direct instruction. Then, finally, the principles and philosophies of Taiji were recorded in written texts[11]; and in the Taiji Classics, one can find phrases such as:

> "With every movement string all the parts together, keeping the entire body light and nimble"[12].

In some ways, this simple description could apply to tensegrity and philosophically they do share some underlying similarities.

To understand why it is best to start with the foundations in the Five Basic Principles. These can be described as follows:

1. Relaxation

Relaxation in Taiji is described by the word "Sung". It refers to a state of relaxed alertness or softness in the body. It involves the release of tension, allowing the body to remain loose and supple while maintaining its structure and alignment. The state of Sung is fundamental to all other principles and it is crucial for promoting energy flow, balance, and efficient movement in Taiji.

2. The separation of Yin from Yang

Also known as separate the weight, this principle focuses on the correct distribution of one's body weight during Taiji movements. When the body's center rests on one leg, then that leg is said to become solid (yang), while the other leg is empty (yin). By clearly distinguishing between these states, our movements can become light, agile, and effortless.

3. Flexible waist

The waist is considered the "commander" in Taiji. All movement originates from the waist, whether it is a hand movement or a step. The waist is where the downward push of gravity meets the upward push of the legs. From this point, it directs the flow of energy through the body, determining its direction.

4. Maintain the body upright

Proper alignment between the head and the spine is crucial for transmitting power between the shoulders and hips. The spine is said to act as a "spring" that connects these two points. It can be either stiffened, allowing force to be transmitted up and down, or relaxed, enabling the spine to twist and turn. To be effective in both functions, the spine must be properly aligned.

5. Beautiful "Ladies Hand"

The hands are part of the shoulder-elbow-wrist connection. When the shoulders are properly connected (through the spine), force can be efficiently transferred from the hand through the spine to the legs and into the ground, and vice versa.

For this reason, the wrists should never be limp. The hand should be 'alive' but relaxed, and maintain a naturally straight and intentional posture.

By analyzing the realizations of Snelson, Buckminster Fuller, and Emmerich, the following properties appear to best define tensegrity:

a. The need for continuous tension (cables form a connected set).

b. Discontinuous compression (no two bars can be connected).

c. Pre-stressed (frameworks are stabilized by a state of self-stress).

d. Self-equilibration (distributing stress while maintaining structural integrity).

e. Minimalism and Efficiency (the achievement of maximum strength with minimal material).

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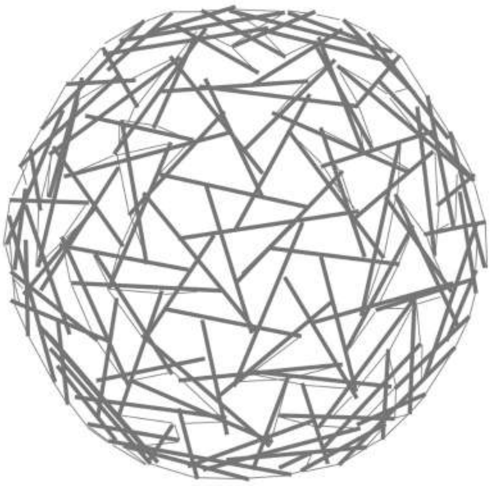

Fig. 4. An example of a geodesic tensegrity sphere.

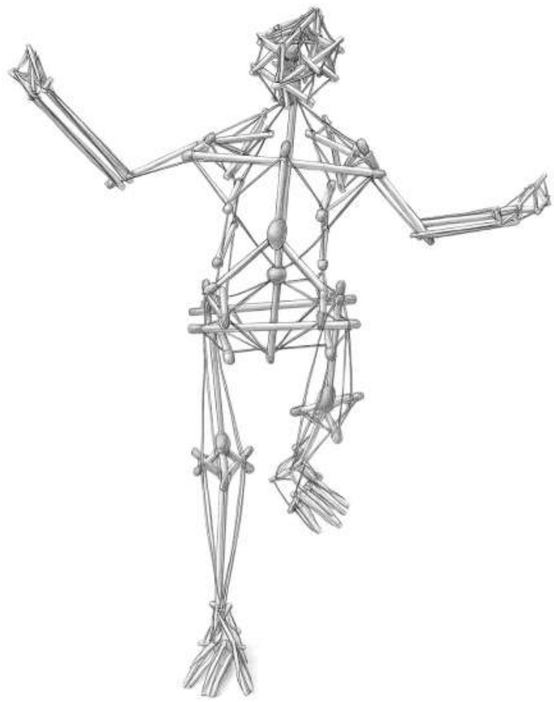

Fig. 5. A tensegrity skeleton.

f. Scalability and Modularity (the ability to adapt different sizes and configurations).

In this model, the body functions as a type of TS-system (a Tensegrity Structure), with the bones acting as compression elements and the muscles, tendons, and fascia providing tension. This holistic view emphasizes the dynamic balance of tension and compression throughout the body, enhancing stability, flexibility, and efficient movement.

2. Model Building

It is very difficult to deliberately create a TS-model to match a specific external shape. Unlike other geometric structures, which can be built by adding pieces one at a time, a TS is incapable of taking its shape until the last rod is connected, and all parts are held in tension. Thus the challenge is to flexibly link these compressive and tensile elements to essentially create a reversible connection between the compression forces experienced by the rods and tension experienced in one or more “tendons”.

Constructing such models requires knowledge of geometry, methods for connecting components, and the use of pre-calculated lengths for each element.

It was found that through using small holes at each end of the wooden rods, made accessible through sawn cuts, it was possible to attach prepared structural tendons of

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Fig. 6. Image of the author with a large tensegrity structure

rubber or rope with pre-calculated lengths (Fig. 7). These holes allow the bands to be fixed in place, while at the same time permitting them to be easily replaced through the sawn cuts with other members of different lengths, whenever this was deemed necessary. This flexibility in building is crucial, as accurate length ratios are essential for the success of creating any TS-model. It should be noted that it is possible to calculate the lengths mathematically; however, even for the simplest TS model with 3 rods these calculations quickly become complex. For this reason, it was found that it was more efficient to start by employing a simplified ratio method (where 1 unit length of rod required 1.5 unit length of tendons), followed by making small adjustments to the model when required. For example, a 25 cm rod would require tendons of 37.5 cm. However, using this method, the side tendons (Fig.14), usually needed to be retightened with slightly shorter lengths in order to increase the structures stability.

Then starting from a planar triangular shape with three rods (Fig. 7), an unequal corner-edge-ratio was introduced and then the structure was conceptually subdivide into smaller triangles by dividing the rod lengths. (see Fig. 8 and 9)

During assembly, all segments must be connected from endpoint to endpoint using the tendons. Each tendon triangle links to the next via a rod and two tendons. Finally, additional tendons connect the outer endpoints (Yellow arrows in Fig. 10). This last step can feel like stretching the 2D pattern over an invisible sphere; but until the last connection is made (Fig. 11) the structure will remain unstable until the 3D shape fully emerges (Fig. 12).

> "Tensegrity structures contain a series of isolated compression elements (rods) that resist the pull of surrounding tensile elements (tendons) and impose a prestress that stabilizes the entire network. These structures may contain different size, shape, and number of building elements, and they may be organized hierarchically. Thus, they can exhibit a wide range of forms that differ from this simple conceptual depiction."

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Fig. 7. Detail view of the connection point.

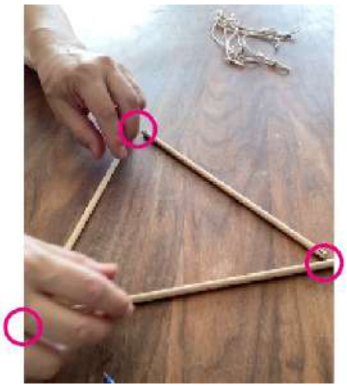

Fig. 8. A triangle shape is showing 3 corners and 3 edges (=equal ratio).

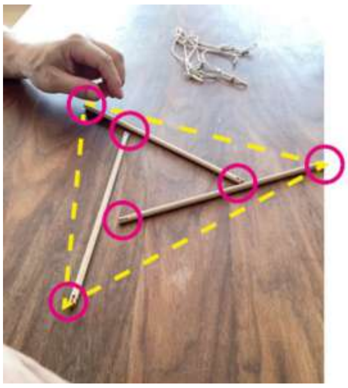

Fig. 9. Unequal ratio through triangulation; with 6 corners and 3 edges.

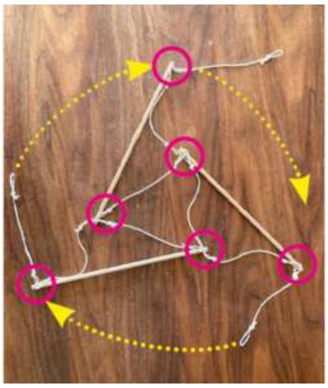

Fig.10. Connecting rods with tendons in a top planar view.

Fig. 11. Still no Tensegrity due to one unconnected tendon.

Fig. 12. After connecting all tendons, the state of tensegrity occurs.

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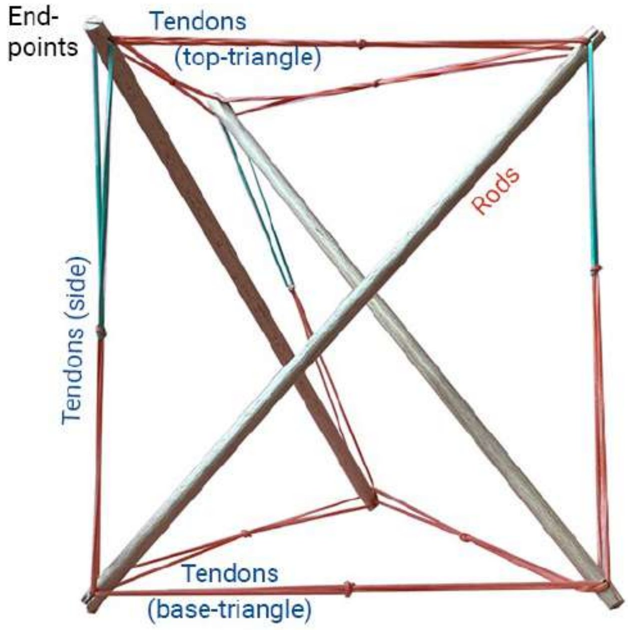

Fig. 13. The 3-strut tensegrity model, often referred to as the 'simplex,' is the simplest and thus most effective model for demonstrating the tensegrity principle.

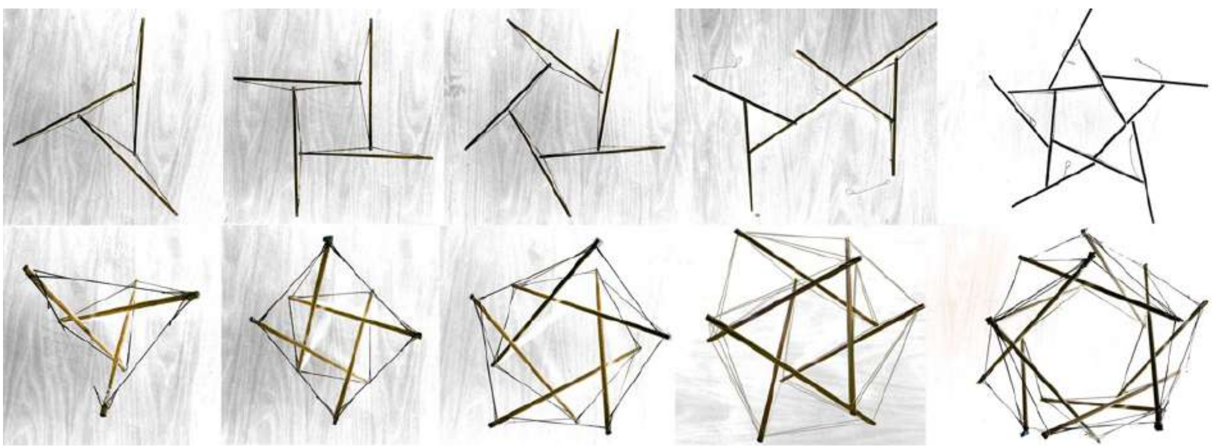

Fig. 14. A series of distinct models with planar initial geometry (top) and the corresponding resulting top view of the respective tensegrity model (bottom), from left to right: 3-strut simplex, 4-strut model, 5-strut model, 6-strut icosahedron, and a composite model combining the 5-strut and 3-strut configurations (2 layers).

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3. Linking Tensegrity of Taiji

As outlined earlier, the remaining core Taiji principles, which embody the heart of the practice, now form the conceptual basis for the following comparisons: Relaxation, Separation of Yin and Yang, Flexible Waist, Upright Body Posture.

To discuss relaxation through a model may seem unusual, but to fully understand its relevance, it is necessary to take a closer look at this simple term. In western society, the concept of relaxation is often associated with a state of mind or the opportunity to lie down and rest. However, rest and relaxation are fundamentally different concepts.

Rest is about restoring energy after stressful tasks and is an essential part of life, such as sleeping. Relaxation, in contrast, is what we aim to achieve during stressful tasks to reduce the energetic cost of activity. In the context of physical activity, the higher the stress, the more important relaxation becomes to avoid wasting energy, to improve joint mobility, and to also increase stability.

In contrast, in scientific terms, relaxation refers to the process of a system searching for its lowest energy state, its equilibrium; or to put it another way, a state of balance where opposing forces are equal and a minimum amount of energy is needed to maintain stability.

And in Taiji this concept is often described by Newton's Law of Motion, particularly the idea that an object is subject to forces and counter-forces.

A person standing on the ground is subject to downward forces caused by their own weight and gravity (Fig. 15a). If the ground does not generate an equal/opposite force (a ground reaction force), the person would sink into the ground. Additionally, the body is constantly influenced by external forces, such as wind or other external sources. Thus, to maintain a stable posture, internal forces within muscles, tendons, and connective tissue must constantly work with each other, to stabilize the entire body; and to achieve overall equilibrium, the body's center of mass must stay above the base of support, in such a way that minimizes the internal energy.

Through small adjustments, it is possible to influence and reduce the total energy required, to move closer to equilibrium. These adjustments can range from major changes in the position of bones and limbs to micro-adjustments within muscles and connective tissue. This is like trying to keep a ball balanced on top of a round hill by adjusting the shape of the hill to maintain a balanced position; and because we perceive all parts of the body simultaneously, it is essential to align and adjust the entire body as a whole. It is not moving individual parts in a sequential series.

In order to maintain dynamic balance throughout the entire body, it is considered essential to align the head, the center of mass (Dantian), and the feet along a vertical axis. For example, when standing upright with straightened legs, the forces are transmitted

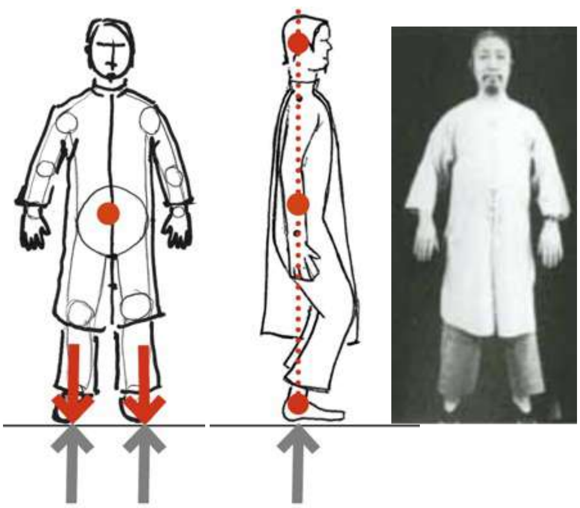

Figure 15 a-c: Downward forces generated by the body (indicated by red arrows) are met with equal and opposite ground reaction forces (grey arrows).

directly through the legs to the ground, requiring minimal additional effort from the leg muscles. While this posture is efficient for the legs, it will increase tension in the back due to a more pronounced spinal curve in an upright body position. Thus, to achieve better overall balance, it is necessary to support the spine by slightly bending the knees and adjusting the hips.

This specific detail is clearly demonstrated in Taiji in the Wuji stance (Fig. 15c), which means "State of Emptiness." It represents a

DOI: 10.57612/2025.JTS.04.03

state of complete relaxation; and this starting position prepares both the mind and body for Taiji movements. By aligning posture and focusing on the breath, the body enters a neutral, balanced state between tension and relaxation.

The key points of the Wuji stance are;

a. feet & knees should be shoulder-width apart, the knees slightly bent;
b. tailbone tucked in;
c. the shoulders should be relaxed, and the chest slightly hollow;
d. arms at the sides, as if holding a ball under the armpits; hands are relaxed yet engaged;
e. the head is upright, as if pulled by a thread; spine straight and elongated;
f. keep the mind clear and undistracted, and maintain deep abdominal breathing (Dan Tien).

Relaxation is essential for this stance. It cannot be forced. This involves calming both your body and mind. While standing in the Wuchi posture might appear simple from the outside, there is a depth of internal activity that can only be experienced, not observed.

Intriguingly, the similar principle of forces being experienced but not observed appear to be applicable to the TS-models. Once the final tendon is connected, even minor tension adjustments can significantly impact the structure. It's not just about reducing tension but sometimes fine-tuning it.

The simplest tensegrity model consists of 3 struts (wooden rods) and 9 tendon cables (rubber bands). Struts bear compressive forces, while tendons handle tension. In the illustrated TS example (Fig. 12, 16 and 17) the compressive forces in rod A-B (red arrows) are counteracted by tensile forces in the tendons (blue arrows). Stability is achieved when all forces balance to zero, preventing movement or deformation. Only in an optimal tension state can maximum stability be maintained with minimal energy. This is the essence of relaxation.

In the video link VL3, you can see how a TS model is gradually corrected, adjusting and

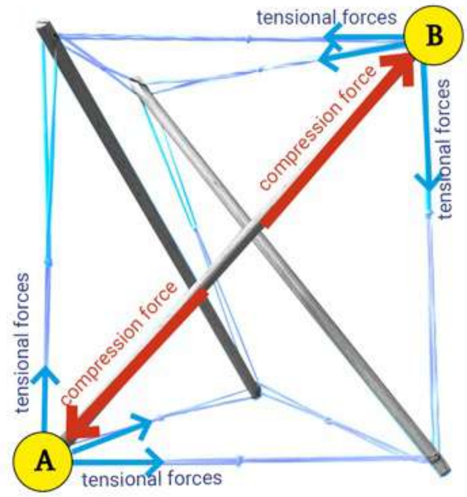

Fig. 16. Set of forces acting on one rod (between point A and B). Tension element (blue arrows) pulling inwards while compression force (red arrows) push outwards. With the right ratio length between the rods and tendons the model becomes balanced.

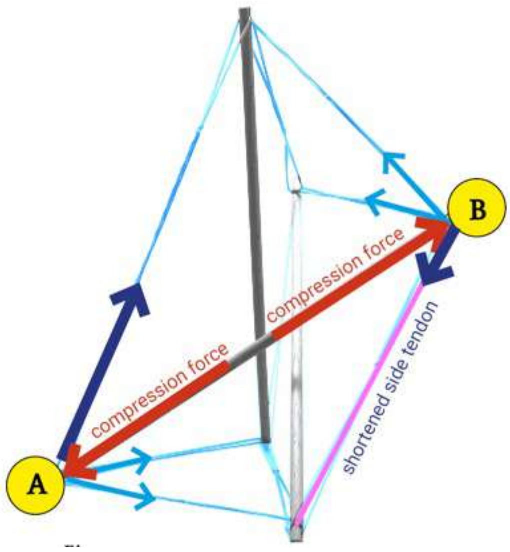

Fig. 17. Unbalanced set of forces with shortened side tendon on the right side (purple tendon).

changing its form. In the end, the position of the imaginary center is lower and directly aligned with the center point of its base triangle; and it appears, visually, as if the model is sinking into a state of relaxation.

Philosophically the benefits of clearly defining Tension and Compression can also be applied to the concepts of Yin from Yang as employed in Taiji. The duality embodied by Yin and Yang consists of two opposing but complementary forces or principles that

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Vol.4 Iss. 1 / June / 2025
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inform all aspects of life and the universe; active and passive; hard and soft, light and dark, and in Taiji empty and full. Yang represents the active, hard, bright, warm, and giving components while Yin is considered to be the passive elements. In the more ancient texts, Yin and Yan was initially restricted to the creation of the universe.

Conceptually these Yin and Yang elements are considered to be in constant motion and interaction, so that they maintain a dynamic balance. They never exist in isolation; each always contains a part of the other.

For example, although day and night are opposing states, they do not exist independently. Even in the darkest days, there is still light, whether it is from the moon or the stars (a small part of Yang is still contained within Yin). Conversely, the day can also contain shadows or moments of stillness (a small part of Yin will appear within Yang). This constant movement and interaction between day and night illustrates the dynamic balance of Yin and Yang, which is never static but always in motion.

In a typical Taiji form, weight is often said to transfer 100% from one leg to the other. The leg that bears the majority of the weight is considered Yang because it is active and stable. The other leg, which carries little or no weight, is Yin, as it is passive and empty, but even when one leg is raised completely off the ground it is acting as a lever and it is connected to the leg that is connected to the ground. Knowledge of these interactions allows your movements to be fluid and controlled. For example, in the movement White Crane Spreads Its Wings: (Fig. 19) The weighted leg is firm and stable (Yang), while the unweighted leg is light and ready to move (Yin).

At the same time, the upper body can also combine Yin with Yang: one arm remains passive and receptive (Yin), while the other is active and giving (Yang); and by consciously switching between these states, Taiji creates a harmonious flow of energy that reflects this balance of Yin and Yang.

Here the most important concept is by separating Yin and Yang, and rationalizing the forces in terms of tension and compression, one can develop a deeper understanding of balance and gain greater control over both body and mind; and in training the form adopts a more rhythmic flow and a more clear direction in both the arm and leg movements. This enables the precise release of energy (Qi) at the correct moment.

Conceptually, another area where tensegrity can aid in understanding the concepts found in Tai Chi is when one receives a powerful blow.

In traditional construction, loads are often concentrated on a few points or surfaces, which can lead to weak points in the structure. In particular, compressive forces, which occur in massive structures like walls

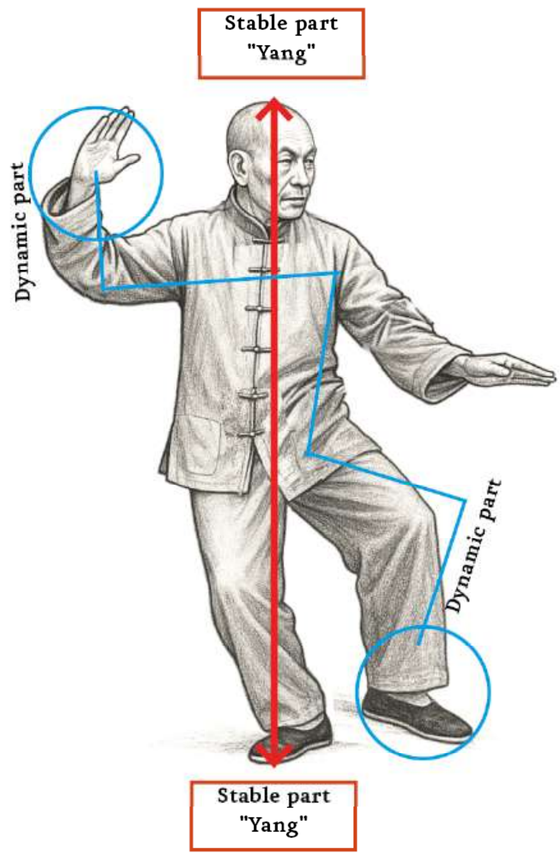

Figure 18: Cheng Man-Ching in the "White Crane Spread its Wings" Positur. In this positur one stands with 100% weight on the right leg.

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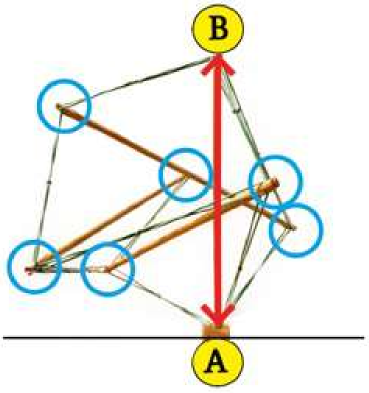

Fig. 19. A 4-strut TS, anchored on point A to the ground, simulates a stable part, between A and B.

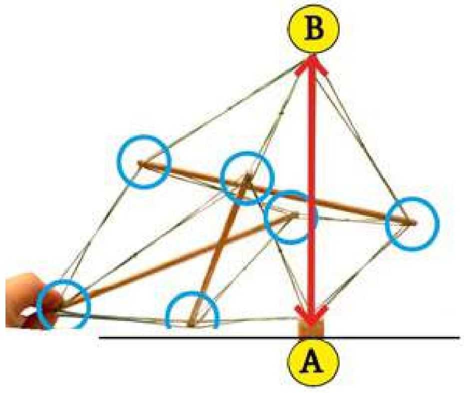

Fig. 22. All other points (blue circles) are showing increased flexibility compared to an unattached 4-struts TS-model

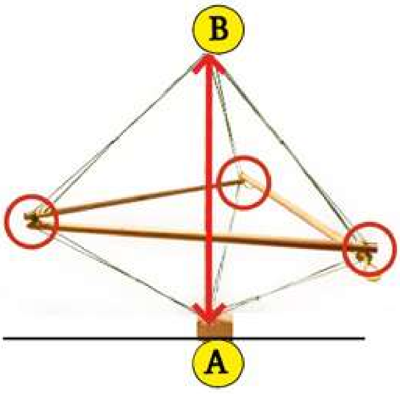

Fig. 23. Another 4-struts model which we may not call for Tensegrity because of its 3 points with direct connected struts (red circles).

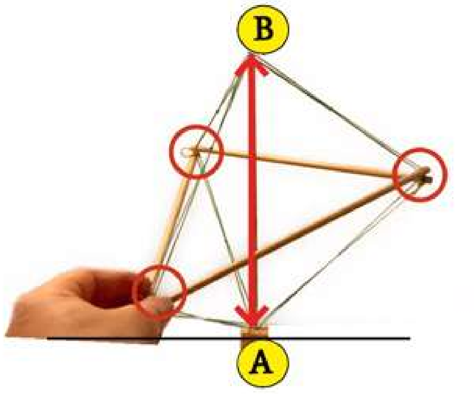

Fig. 24. This model is not showing the same flexibility as model in Fig.17.

or columns, can often lead to deformations, cracks, or even collapse when the load becomes too great. To prevent this, traditional constructions will often need to be reinforced at these points, which requires more material and stronger connections.

However, in TS-Systems the loads are evenly distributed throughout the network through continuous tension, making the structure more resilient and flexible. This flexibility means that the discontinuously placed compression elements can better absorb shocks and deformations, without breaking.

As I stated in the introduction, TS-structures exist through separating the two elements of continuous tension and discontinuous compression; and like the concept of Yin and Yang, these two opposing forces work together. You cannot think of them separately, or employ them separately. If you separate them, the structure will always collapse.

A simple tensegrity model can simulate this 100% weight shift onto one leg or a stable axis (Yang). To do this one rod is firmly anchored to an underlying table (Fig. 22). Then by subsequently applying force by hand, it is possible to observe and also feel the properties of the Yin elements. The result is a remarkably degree of flexibility and mobility in these parts, compared to the original, unattached model (Fig. 22).

Furthermore, it is possible to demonstrate how constructions that are similar but not

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precisely built according to the principles of TS exhibit more restricted mobility.

In a second model, I also used four rods and the necessary rubber bands, but in this case three rods were directly connected at their ends to form a triangle (Fig. 23).

Though this model may resemble a TS-structure, the direct connection of compression rods contradicts the rule of tensegrity, which prohibits two bars being connected. Additionally, the compression rods in this TS system are positioned on the boundary surface. Many tensegrity purists consider this area to be exclusively reserved for elements where this role is played by tension. As a result, they introduced the terms "pure" and "false" tensegrity[1].

Compared to a pure TS-Model under the same conditions, a false TS-model displayed noticeably lower flexibility (Fig. 24). This suggests that the discontinuous properties of structures offer noticeable advantages when forces are applied appropriately and consistently. (see link VL4)

The third analogy surrounds the need for a Flexible Waist, to aid the coordination of movement and structural synergy of all components

The waist acts as the central part of our body. It connects the upper and lower sections, and together with our spine, it plays a key role in unifying all parts of the body.

When the upper and lower body are connected, the entire body can move as an integrated whole: the movement of the legs is coordinated with the movement of the arms, the elbows are coordinated with the hips, and the feet are coordinated with the hands. In The Taiji classic this is embodied by the sentence, if one part moves, the whole body moves. In the Taiji posture Grasp the Bird's Tail (also known as Ward Off, Roll Back, Press, and Push), in every movement whether it's turning the waist, a shift in weight, or simply extending the arms the movement involves activating the entire body.

If you move just your arms or just your legs without engaging the whole body, the movements will feel disconnected and it will lack the smooth flow of energy that Taiji aims to achieve.

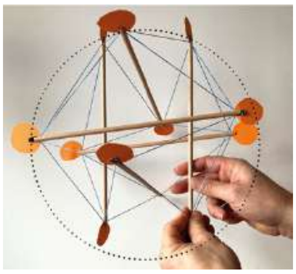

Fig. 25. A 6-strut TS icosahedron With orange dots at the outer endpoints.

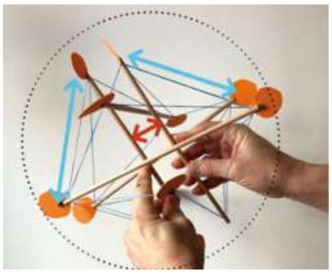

Fig. 26. When compressing two struts, all orange dot moves inward.

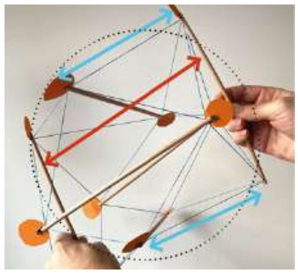

Fig. 27. When expanding to struts, all orange dot moves outward.

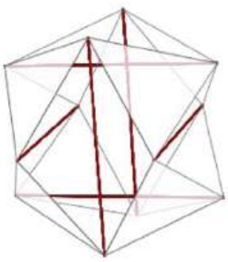

Fig.28. Icosahedron with solid triangular faces to illustrate the volume.

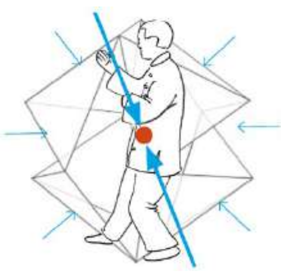

Fig. 29. "Lu" (Roll Back posture) with compressed icosahedron in the background.

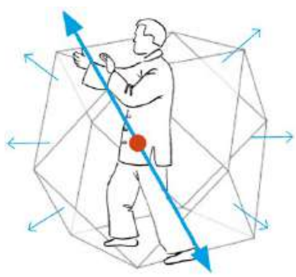

Fig.30. "Peng" (Ward Off posture) with expanded icosahedron in the background.

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To explore this principle, we can take a closer look at a TS-structure called the icosahedron model (Fig. 25). With its six rods, this model is one of the most famous tensegrities. It is often used in the field of biology to explain processes in the human body or, more generally, in nature. This model also exhibits mirror symmetry, which makes it easier to identify surfaces within the model (Fig. 28) and it also simplifies research, as we are more accustomed to observing straight angles.

When this model is stressed at a specific point, the tension in the tendons and compression in the rods adjust throughout the entire structure. No single part moves independently; instead, all elements of the structure respond to maintain balance.

When two points in the model move apart, the distances between all other parts also expand, creating a state of expansion (Fig. 27). Conversely, as these points move closer together, distances decrease, resulting in compression (Fig. 26). This auxetic response is especially interesting, as it closely mirrors the two fundamental forces in Taiji, Peng and Lu, which exhibit similar patterns of expansion and contraction.

Peng (Ward Off posture, Fig. 30) is the force expressed by an increase of tension in the body, which leads to an expansion of all body parts. When someone is standing in the correct Peng posture, it is almost impossible to move them, and incoming energy is bounced back. A Lu (Roll Back posture, Fig. 29), on the other hand, is expressed by releasing all tension, in order to redirect an incoming external energy. This compressive form leads the incoming force into emptiness, causing the opponent to lose balance.

This comparison between Taiji and the TS-icosahedron also shows another interesting feature. When we expand or compress two struts, the tendons don't need to stretch much to accommodate the movement of the struts, as they are usually designed to be quite flexible.

This results in a large visible change in the positions of the struts, while the tendons only undergo very small changes in length. Here you can compare the lengths of the blue and red arrows in Fig. 26 and Fig. 27. The tendons adjust their tension to maintain overall balance, rather than significantly elongating. As a result, the struts move more (red arrows) than the tendons stretch, making the change in the distance between the struts much more noticeable. V. G. Jáuregui describes this phenomenon in his studies on elasticity multiplication, and it highlights the remarkable efficiency of TS-systems, where minimal elastic deformations lead to significant structural adjustments in the struts.

Conceptually, this phenomenon provides an explanation for why we employ small subtle internal shifts and weight redistributions in the body. These shifts enable fluid, full-body movements, with large and powerfully coordinated flows. (See link VL5)

Turning now to the concept of an "upright body", when I first began to learn Taiji, I was surprised at how often my posture and body alignment needed to be corrected by my teacher.

The concept of keeping an upright body sounds so simple. The rule for the correct posture and alignment of the head, torso, and hips corresponds to the same rules already explained in principle #1 for relaxation. However, the issue at hand is that you are often, simultaneously, in motion or you may have just completed a movement and you may have taken on a different posture with your legs and arms. Thus, coordinating and realigning your body, especially in connection with movement, is not such an easy task. But the associated benefits of 'proper alignment' are certainly clear. There is a more even weight distribution, an increase in stability and it is easier to protect the joints; the creation of better power or energy flow (Qi), by avoiding blockages in the body; an increase in efficiency of movement, and an upright well-aligned body does not need to expend unnecessary energy to compensate for misalignments. This is why it's so important in Taiji to regularly check the alignment of the body, to ensure that you're maintaining the correct posture.

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4. Discussions and Conclusions

For some practitioners of Taiji, who find the concept of holding one's head up as if it was attached to a piece of string to be ineffective it just might be beneficial to consider that the body is being supported not by a string from above, but imagining that forces surround them from all directions, as if the lines of forces are constructed like a tensegrity Tower or Mast.

In studies of tensegrity masts, it has often been observed that even slight changes in the angle of a single rod could lead to misalignment of the entire structure. With further angle adjustments, the mast can quickly reach its structural limits, which results in the structure collapsing under the resulting misaligned forces (see link VL6).

So, not only does the proper relationship of tension and compression help stabilize a structure like the human body, but precise alignment also ensures that the correct tone is established between the forces, leading to a harmonious balance.

When practicing Taiji, numerous approaches and techniques exist to help practitioners internally visualize their posture and movement. For some, the simple image of the head suspended by a single thread from above may suffice. Others, however, might benefit more from a deeper understanding of the body's interconnectedness, and how tension and compression works together within a unified structure. This perspective thus could offer some fresh insights into why certain movements are executed in specific ways.

While Taiji movements appear simple and efficient on the surface, the principles behind them are often layered and profound; and they can reflect complex interplays of biomechanical, energetic, and philosophical elements, each building upon the last.

And this finally brings us to the broader question: can the aesthetic and structural qualities of tensegrity sculptures influence Taiji training—perhaps even in the context of performance or competition? The answer, at least in part, is yes. Generated tensegrity forms are visually compelling and conceptually rich. They exemplify how structural principles can be harnessed to create art, where, as mentioned earlier, the framework itself becomes the art.

But challenging questions still remains: can tensegrity structures replicate not only the external forms of Taiji movements, but also the internal thought process, and the intention and awareness behind them? This work has shown that this may indeed be possible, even if many questions remain unanswered. What emerges is an open field of inquiry, inviting further exploration. The interplay between art, science, and movement is far from fully realized.

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