



# Piano Design Optimization: Practical Improvement Modifications for Enhancing Performance Effect

Yuze Sun

Victoria Shanghai Academy, Hong Kong, China.

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\***Corresponding author:** Yuze Sun, Victoria Shanghai Academy, Hong Kong, China.

## Abstract

The piano, as the "king" of the musical instrument family, is a product of the development of human spiritual and technological civilization. The emergence of the piano as a musical instrument is a demand for human social life, and the development of the piano reflects the continuous development of human social and spiritual life from one side. The piano, as a material foundation, provides conditions for the creation of musicians, and the piano culture created and developed by musicians promotes the further maturity of piano structure and function. A good practice method and correct attitude towards piano practice will greatly improve the efficiency of piano practice, ultimately improving the level of piano performance. For a piano performer, it is important to proficiently master the basic essentials of piano performance. To learn the piano well, it is necessary to have solid basic skills, constantly summarize experience, and master basic playing skills in practice.

## Keywords

Introduction, Piano, Techniques, Piano Performance

## 1. Vibrato pedal

### 1.1 Major inspiration & and justification for design

Many magnificent pianists and piano composers have long been fascinated by the vibrating delight of opera singers, one great example of this would be the Polish Pianist and composer Frederich Chopin, whose lyrical style mainly originated from his visits to opera houses and listening to the melodious flow of each note sung by the singer. Many modern instruments also have the ability to produce vibrato including string instruments, guitars, woodwind, and brass instruments, leaving the most percussive instrument outside of the group, so thus I intend to endow the vibrato onto the pianoforte, to not only accentuate the absolute beauty of lyrical melodies but to also open up a new door for experimental composition in relation with sound waves.

## 2. Design outline

A new material of a sound-absorbing foam will be placed within the sound chamber of the piano

**Operative synopsis:** the performer will hold the vibrato pedal up and down smoothly to manipulate the level of volume produced by the notes manually, achieving a vibrato effect.

**Operative reminder:** similar to the sostenuto pedal, the vibrato pedal may sometimes be slightly difficult to maneuver in slightly faster tempi in numerous lyrical piano solo pieces, as the exact note within the melody must be executed in the same time along with the vibrato pedal to allow the string of that note to enter the "manually maneuverable vibrato slot (MMVS)1" and have its volume maneuvered as the piece progresses. In many cases, if the note desired for vibrato is arranged at the same exact time as the accompaniment, the performer might have to execute

that note slightly before the accompanying notes to more easily place that note into the “manually maneuverable vibrato slot (MMVS).

### 3. An alternative solution to the aforementioned concern

When the accompaniment and the melody must be played at the exact same time, all of the accompanying notes may be executed as a staccato with the damper pedal rather than a prolonged note, which prevents the vibrato pedal from having an effect on the accompanying notes, thus isolating the melodic note to be affected.

Manually maneuverable vibrato slot (MMVS) refers to the exact time window in a piece where the vibrato pedal is pressed down at the exact same time as the note being played, and after a note is placed within this slot, complete manual control over the volume of that specific note is given to the performer.

#### 3.1 Operative tips

Common pedal combination suggestion: Could be combined with the sostenuto pedal to increase the contrast between sustained bass and vibrating melody (the bass section as a drone or harmonic support, like in an orchestra where the cello or double bass or tuba plays a sustained note).

### 4. Crescendo pedal

#### 4.1 Popular usage manual

**Major usage:** gradually increasing the volume of one held-down chord or note, or sounds sustained by the damper pedal.

**Secondary usage:** with the lifting up of the pedal, there will be a swelling of volume, unlike the traditional slow attack increase, as the volume of the strings gets less suppressed and more projected.

**Tertiary usage:** To suddenly suppress the volume of the keys, could be seen as another version of the una corda pedal, where volume is suddenly held down.

**Operative synopsis:** The performer presses down the crescendo pedal at any time in a piece, and the level of volume suppression will be based on the level at which the pedal is pressed, and a crescendo effect is achieved through the gradual or sudden lifting up of the pedal, in which lessens the volume suppression on the strings and widens the sound.

**Operative reminders:** To achieve the best crescendo effect using this pedal, it's suggested that whenever the pedal is pressed down the performer slightly increases the attack or volume of their playing considering that the volume of the keys when the crescendo pedal is fully pressed down is to a certain extent suppressed, so there might be an apparent decrease the volume without manually increasing the attack.

### 5. Glissando/microtonal pedal

**Design outline:** For the most elaborate model of this pedal, 26 subsidiary strings will be positioned between 2 semitones, and behind the existing two strings(a and a#), each rising in 1.00615385 hertz (it could be rounded to 1 hertz in a simpler model). When the pedal is pressed down, these subsidiary strings will be moved forward, aligning with the rest of the piano strings. In order for these extra strings to be strummed by a hammer, rolls of hammer corresponding with each string will be embedded behind the strings, hitting the strings from the inside of the piano to the outside, rather than outside to the inside like the normal strings and hammers.

**Operative synopsis:** When pressed down, playing one key on the keyboard will result in triggering a series of subsidiary notes slightly higher than the note performed(the number of notes triggered could range from 26, 20, 15, or 10 depending on the model, the more notes triggered, the smoother the glissando effect will be), but is all lower than the semitone next to the note.

### 6. Drone pedal

When pressed down any note being played will be sustained and act as a drone, until the pedal is released, in which the drone will disappear. The mechanic is similar to the traditional sustain pedal, where the degree to which the pedal is pressed down determines the volume of the droned note.

## 6.1 Modified soft pedal

This pedal combines the 2 traditional timbre-softening mechanisms into one, whereby pulling the pedal down and pushing it to the right, a sheath of wool will block the hammers, thus producing a muffled sound.

Additionally, when pushed to the left, the hammers will be pushed to the right, hitting only 2, rather than 3 piano strings, decreasing the volume.

## 6.2 Celestine pedal

When pressed down, a roll of tuning forks used for the sound production of a celesta will be pulled forward, replacing the piano strings, this allows the piano to produce a timbre similar to the celesta.

**Design outline:** 88 metal bars used for a traditional celesta will be embedded behind the piano strings, when this pedal is pressed down, those metal bars will be moved forward, while the piano strings will move backward, allowing the bars to replace the strings. The hammers will be modified to an intermediate between a piano hammer and a celesta hammer to generate a decent sound by strumming both materials.

## 7. Relaxation of fingers, wrists, shoulders, arms, and elbows

The ten fingers are the most direct and sensitive part of playing the most forward whistle. Therefore, the strength, sensitivity, speed, and ever-changing touch and control ability of the ten fingers are the foundation. The support and uniformity of the ten fingers are one of the most basic requirements for elementary piano training. The strong and elastic support of the finger joints is a crucial issue in the first place (Mikio, 2020). Usually, we can long-term, Conduct extensive finger lift training to achieve rapid finger movement; There are many effective methods for finger technique training, which can increase the continuous internal force of the fingers by lowering their fingers as little as possible

### 7.1 Finger relaxation

When it comes to piano performance, what we often pay attention to is the playing skills of the fingers. The fingers are the creators of sound and the executors of piano performers' ideas. In piano learning, the quality of sound comes from the way the keys are touched, and the correctness of the keys not only affects the basic sound quality but also the key to relaxation or tension when playing the piano (Florian, Eckart, & Kristin, 2022). Usually, when playing long pieces of music, fast phrases, colorful passages, and octave techniques, we may experience tension, tightness, and soreness in our hands, or the tone may be unnatural or not full. This is because our hands have not relaxed in a timely manner and we have not arranged the alternating coordination of tension and relaxation in a timely manner. What exactly is 'relaxation'? How can one correctly relax, achieving fullness, grandeur, and power when playing strong, beauty, softness, and quietness when playing weak, clarity, uniformity, and liveliness when playing fast, and elegance, elegance, and meticulousness when playing slow? Pianist Wang Bin said in her piano lecture, "Correct relaxation is a state of 'active rest' (Gregor, 2020). It is active, conscious, and skillful to make it effortless and very comfortable at all times, and all parts of the body can be relaxed, while also allowing it to freely transition into action at any time. This kind of relaxation is relatively tense, as it involves removing excess force rather than collapsing and loosening the hand. The keys are not pressed to the bottom, there is no force, and there is no need for force. When performing a certain playing technique, it is often easy to develop muscle tension unrelated to the playing action or moderate muscle tension related to the playing action due to maladaptation. Emphasizing relaxation in skill training is to overcome these two types of inappropriate tension. After the player's fingers drop the keys, they should immediately find a sense of relaxation. The fingers should stand on the keys, while the muscles and other unused fingers at the fingertips and arms are in a state of elastic rest. There is no need to continue applying pressure. As long as the fingertips are properly left on the bottom of the keyboard, the playing sound will be natural, full, and beautiful.

### 7.2 Relaxation of wrist

The wrist is the hub connecting the palm and arm, the remote control for transmitting arm power to the fingertips, and the key to various tones and playing techniques. In the training of techniques such as legato, staccato, scale, chord, octave, and doublet, the wrist plays a crucial role (Teri, 2020).

The sixth variation in Yu Dacheng's "Variations" is composed of an octave legato in the melody of his right hand.

If his wrist joint becomes stiff or blindly forceful during playing, it can make the sound unpleasant and lead to exhaustion. In our usual octave practice, we can first use the rhythm of triplets to relax our wrists. On this basis, we can gradually practice the pentatonic and hexatonic notes from slow to fast, so that our wrists can relax during rapid performance. Mendelssohn used the decorative tone tr to represent the ripples of water in "The Venetian Boat Song" (Wai Tung, 2020). When practicing playing the decorative tone tr, his fingers can first stand on the keys. In the process of quickly alternating between the two fingers, the wrist plays from bottom to top, relaxing the wrist and improving the speed of playing the decorative tone.

In addition, you can also experience the difference in wrist strength through comparative exercises of linking and jumping notes. Jumping notes use slight wrist tremors to drive fingers to touch keys, and the direction of wrist movement is up and down; Connected with a moving wrist.

## 8. Practice mastering basic key touching techniques

### 8.1 Nonlegato

Before touching the next note, promptly lift the finger playing the previous note and ensure that the sound of that note does not continue, which will eliminate the legato and produce a nonlegato effect

### 8.2 Semilegato

As mentioned above, if the gap between these two notes is larger, it will produce a semi-legato effect. Semi-legato is represented by adding points and lines to the music score. Semi-legato is generally used for "slow playing", so it is usually only applicable to relatively calm music. Semi-legato and nonlegato are obtained through finger technology. On the one hand, it is achieved by the wrist joint, elbow joint, and even the Shoulder joint to send out "throw" and "fall" actions, On the other hand, the bonding method is also used, especially the bonding method that is mixed with various bonding possibilities mentioned earlier

### 8.3 Staccato

It is represented by a dot or inverted triangle. The dot represents half of the value when playing the Note value, and the inverted triangle represents 1/3 of the value when playing the Note value The playing effect of staccato is similar to that of nonlegato. Its characteristic is that the specified duration of the notes is not maintained until the end, and the notes are played intermittently and individually. It is also a distinctive playing method in piano performance, which can be divided into four basic playing methods based on the musical requirements of the piece being played and the different parts of the hand used.

## 9. Conclusion

It has been said that "a performer must obtain the sovereignty to manipulate the piano, and this control is technology. But skill is not art, it is only a means to win art, and it is the builder of the road to art." Piano performance is an art that requires the performer to possess their inherent talents and unleash their creativity to perform. On the other hand, it also requires the performer to master basic skills, A deep understanding of the ideological content of the work, and a more comprehensive grasp of the music style of the work, allowing the performer to fully utilize the space for secondary creation, can provide a more complete interpretation of the work, and enable the performer's thoughts to be highly unified with the content that the composer wants to express. As the saying goes, 'Practice makes perfect'. The success of piano performance cannot be achieved in a single day but requires repeated training. Proficiency in skills is an important measure of whether a performer has a high level of proficiency. The skills of piano performance include many, and the skills required for different periods and styles of work vary greatly, but the basic skills still have certain standards. This paper mainly elaborates on human hand skills from the aspects of finger touch, finger singing, coordination of movements during playing, and the use of pedals. The ten fingers of a person are the most sensitive parts of a performer, and their strength, sensitivity, speed, and various key touching methods are the foundation for the performer to play the piano. Although it is necessary to practice according to personal weaknesses, the basic practice method is still roughly similar. The process of learning the piano, like other subjects, must follow a common law: from shallow to deep, and gradually. As the level continues to deepen, the time spent practicing the piano also needs to increase accordingly, which is essential. But how to achieve the expected goal with the fastest speed while performing

the work perfectly in the shortest possible time requires us to carefully consider it.

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