

Moving Beyond the Traditional Piano: A Literature Review of Extended Techniques and
Electronic Enhancements

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Abstract

The purpose of this literature review is to decrease the gap between pianists and the contemporary music by exploring piano extended techniques and the relationship between piano with electronic music implications. Due to technological developments over the last decade, most areas of study influenced dramatically. The paradigm shift in technology also played a vital role in the musical world. The electronic music movement emerged with developing recording techniques. This affected the perception and the performance practice of contemporary music.

Regarding the written scores and the performances, which are getting more complicated each day, the need for a detailed instrumentation guide became an indispensable requirement for performers. Learning contemporary music for the piano requires a considerable amount of time for pianists to decode the notation such as translating new symbols or old symbols in new ways, studying new extended techniques, and studying the relation between symbol and physical gesture.

The problem is the miscommunication between pianists and contemporary music regarding technical issues. The solution for the current issue will be investigated with three main subjects; notation, electronics, and exemplifications of significant literature scores. The notation of extended techniques is not only covering symbols and dynamicity of the music but also electronic implications in various ways such as usage of midi and synthesizers, the cooperation with fixed and live media. This is an elaborate hand guide for pianists who are new and having a struggle with contemporary music performance.

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Introduction

Traditionally, a pianist develops intimate techniques of touch on the keyboard. Piano techniques expanded dramatically during the romantic period. These techniques demand a high degree of performance, followed by finger strength, wrist strength, and arm span (Zhu 2018). The advancement in piano performance has taken piano playing techniques to a new standard.

Across the twentieth century, this approach was extended. There has been a huge evolution and extension of the sonorous possibilities of traditional instruments. In creating new sounds, the piano has demonstrated a remarkable potential for creativity. A large number of composers have incorporated expanded techniques into their piano composing in the last 50 years (Proulx 2009). Composers have made new demands on pianists, introducing not only compositional and technological developments to piano music but also a profound shift to the meaning of music.

The concept of music by Varese focuses away from standard means of composition and performance, it goes further into the science of sound masses, on which the structure of the tracks themselves is more centered (Varese, Wen-Chung 1966). Basically, the music itself is a collection of arranged noises, and its sound structure, meaning its timbre, is the most significant element that plays within its sounding qualities. Combining these opposite views, any sounds that a performer can make can be used in a composition.

The purpose of this literature review is to demonstrate a fuller range of musical sounds with the piano. Methods are explored in three trends in the literature: extended piano techniques, electronic music, and the combination of the two.

Piano Extended Techniques

Although many composers in the nineteenth century were preoccupied with the variety of timbre, the piano was limited in timbre possibilities at the time. Key features in nineteenth-century music such as rhythm and harmony were no longer the most significant compositional characteristics of their works in the twentieth century for many composers (Ishii 2005). To clarify, with the development of music resources, the opinion of composers begins to change.

The view of music shifted with the introduction of extended techniques in the twentieth century. The common view is the performer is the one who makes music. The thought is “Music is made by a performer. It comes from him rather than from his instrument, the instrument being merely a vehicle. Therefore, it seems logical that any sound a performer can make may be used in musical composition” (Cope 2001, 50). There has been a dramatic leap in the performing methods of many styles of classical instruments since the twentieth century. Regarding the collected data, a number of important piano techniques were developed during the twentieth century.

Inside Keyboard Playing

As traditional pianists work by playing on the keys to explore numerous tone colors, the contemporary pianist needs to create them by performing on the strings or anywhere else that is required. For instance, when asked to hit the soundboard with fingertips, it would not be enough to merely tap the nearest position on the soundboard (Vaes 2009). To clarify, in order to find the sound that the composer wants and is suitable for the piece, the pianist must try several different choices.

There are several methods of performing inside the keyboard, such as plucking the strings, striking the strings, stroking the strings, glissando, pizzicato (Proulx 2009). These techniques include playing with fingertips, fingernails, or hands directly on the strings.

Plucking the strings is the most popular method. In order to make strings vibrate there is a need to hold the damper away from the strings that will be plucked. The string vibration can be demonstrated in three ways 1) using a sostenuto pedal, 2) the key that refers to the string is depressed and held silently 3) the damper pedal is depressed (Ishii 2005). Pianists can pluck the strings by fingertips or fingernails very much like a guitarist, harpist, or cellist. This technique of plucking the piano strings is also used to mimic the electronic effect while combining the acoustic and electronic sounds (Feng 2018). To sum up, piano extended techniques were also used for imitation of the electronics which plays an important role in changing the perspective of the compositional approach.

Striking the strings is also a common method. Pianists perform this method by hitting the string with either fingertip, fingernail, or palm of the hand. The damper pedal is normally depressed as the palm reaches the strings to form a massive sound. The pianist will quietly depress the keys corresponding to the strings and keep them with fingertips or with the sostenuto pedal when particular pitches to be struck are indicated in the score (Ishii 2005). To clarify, if the performer presses the keys silently, the mute of those selected keys will be removed. Thus, when the strings inside the piano are played with fingertip, nail or even hitting all the strings as a cluster with the palm of the hand, only the pressed keys will resonate.

Rubbing the string with the fingertip or scratching the string with the fingernail around the length of the string implements the stroking of the strings. To signify the direction, there is always an arrow in the score if the performer has to stroke the strings in a certain direction. If

there is no defined indication, the motion should be made towards the performer (Stafford 1978). As described above in order to let the strings free to vibrate, there is a need to use the sostenuto pedal, depress the damper pedal, or keys should silently depress and be held with one hand.

Pizzicato and the glissando are also conducted on the strings, yet to perform a mute or a harmonic, the fingertips merely strike the strings, gradually adjusting their response to the key-hammer mechanism's usual operation. Glissando is performed by sweeping a finger or group of fingers around many strings, which makes the piano sounds like a harp. The string glissando is soft and chromatic. In order to reach a mezzo-forte dynamic, the performer needs to dig deeper into strings while sweeping them (Proulx 2009). Therefore, this makes a huge difference regarding the timbral content. Performers should consider whether the musical passage should be played as piano or forte and in regard to the strings should be played in-depth or touchingly.

From the methods of extended techniques, Glissando is the most difficult and problematic to be performed. In order to be understood glissando, there should be some implications in the score. In historical chronology, the term glissando came into use in the 1820s, and before that, it was rarely described in the score (Vaes 2009). The glissando technique could also be recognized from other notational circumstances such as repeated fingering indications 111111 (for downwards single-note right-hand glissandos) or 42424242 (for double-note glissandos in 3rds). Other signs were used long after the word “glissando” had become a standardized indication. A straight line was frequently drawn in the 20th century to cover the real notes of a glissando (Ishii 2005). This makes it easy for the composer and copyist to delete the very needless writing in a glissando from all the notes.

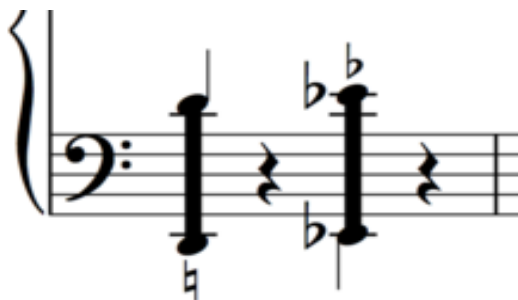
“Five Pieces for Piano” George Crumb

George Crumb is different from other contemporary composers who have explored non-traditional devices that alter the timbre. He is known for alternate types of notation, unique timbres, extended instrumental and vocal techniques that achieve dramatic sonority (Chun 1982). Hence, Crumb is a master in incorporating a range of sonorities and textures into a creative entity.

Five Pieces for Piano is the piece that characterized his style and the role that he now occupies in contemporary music of the twentieth century. Regarding the extended techniques and the theatricality combined with Crumb's musical style, *Five Pieces for Piano* needs particular attention to physical self-awareness on the part of the performer (Lee 2019). With accurate and consistent notation, Crumb provides detailed instructions, in which he clearly shows how to create the sonic environment that lies beyond the border of the page. These guidelines make it easy for performers to understand the extended approaches Crumb was experimenting with.

Cluster

The second approach to extended techniques is to play pitches in clusters. Early in the twentieth century, this technique emerged in different compositions. Depending on how many notes should be used, clusters can be played with the fingertips, the thumb, the fist, or the arm (Proulx 2009). There are three ways to play a cluster, each used for unique sonority intentions. A white-key cluster, black-key cluster, or mixed (chromatic) may be formed on the piano and the *cluster tone* is the most important from special keyboard techniques (Ishii 2005). On the piano, cluster techniques can be performed either on the keyboard or strings. Thus, the cluster is used for its sonority, not for the harmonic implications



Example 1: Cluster Tone

Henry Cowell made the greatest attempt to encourage this approach as a legitimate musical operation (Vaes 2009). He defined the cluster in his first published paper, *Harmonic Development in Music* (1921), as: [...] a convenient term to indicate two or more minor seconds in juxtaposition, struck simultaneously and used as a unit. (Hicks 1993, 445). It is reasonable, though, that we refer to him to see exactly what he had in mind.

Pedal Function

Traditionally, piano pedals help to change the instrument's sound in various ways. Kicking the pedal of the piano fastly and powerfully will produce a huge sound consist of the whole keys resonance, while lifting the pedal will produce a percussive sound (Ishii 2005). This technique is widely common and has very significant timbral content. It matches with the percussion section in the orchestras and large ensembles.

One of the piano pedal extended techniques is catching the present resonance. When the sustaining pedal is depressed directly after playing a note, the dampers will not have enough time to completely dampen the echo and lifting them soon would cause the excess vibrations to ring through. Lifting the dampers through the pedal again takes up a portion of the not entirely dampened tone for the newly opened strings (Vaes 2009). The impulse of the attack is not conveyed to the open strings with the captured resonance, and only sound waves in the air and

the soundboard will cause their sympathetic vibrations. Therefore, the request of gradually, halfway, or even less depressing and lifting the sustaining pedal or una corda are very common in twentieth-century compositions. Those positions of pedals regarding gradations in the movement are considered as extensions.

Prepared Piano

A prepared piano is a piano where the sound has been altered by inserting items such as bolts, pins, keys, erasers, weather stripping, wood, and material between the keys. Bolts correspond to harmonics, nuts, and bolts in a metal resonance, a piece of rubber inserted between the strings results in a dull thud of harmonics (Nelson 1987). This means that the resulting sound is determined by the kind of material placed between the strings, and also the stage that it is placed outside the damper or bridge.

This concept of the *Prepared Piano* was developed by John Cage in 1940, and he created a considerable body of works featuring his unique hybrid (Tzenka 2008). As Tzenka refers to Cage's works, the prepared piano concept drops a huge bomb in the middle of contemporary music. Cage describes his approach as "experiment must necessarily be carried on by hitting anything- tin pans, rice bowls, iron pipes-anything we can lay our hands on . . . We must explore the materials of music."(Cage 1961, 45) Hence, any item could be an instrument and the sound created by them included to the music. Moreover, when performing in a prepared piano, pianists should be aware that is not just about placing the object and inserting it carefully.

The preparations should be chosen carefully by the composer's requirements and also the taste of the performer. Two factors that pianists should consider before choosing the preparations are 1) while the preparation size correlates directly to the corresponding pitch, the performer should choose the size of the preparation, and if the pianist wants the sound generated by a larger

preparation, he should raise it by longitude, not by diameter 2) Second, as specified by the composer, the width of the preparations that are wedged or connected to other preparations, such as washers, should not rest on or touch other strings (Elder Dave 1993). The pianists should be aware that whatever preparation they decide to choose, should accommodate the placement in the instrument. Also, the performer should never force placing an object into the strings which would cause harshness in the instrument











“Bacchanale” and “Sonatas and Interludes” John Cage

John Cage is an Avant-garde American composer whose innovative works and unorthodox ideas had a profound effect on music in the mid-20th century (Jeong 2014). His experiments and the innovations of the prepared piano have a great impact on the new music world and extended techniques by breaking the limits of musical language and something that was never heard before. Cage was not the first to use papers among the piano strings, but he was the first to create and adopt the prepared piano (Ferreira 2010). Thus, he was the pioneer and the sonority of contemporary music changed after. The piano was not as innovative as strings or other instruments because of the limitation of 88 keys. The instrument could not produce any other sound than the 88 keys until John Cage broke the rules and destroyed the boundaries. John Cage’s musical comprehension is very likely to M. Schafer as both composers are interacting with soundscape (Caglarcan 2019). As Cage defines his approach, “Music is sound, sound around us whether we’re in or out of concert-hall” (Schafer 1966, 5 as cited in Caglarcan 2019, 14). Any sound is now available to produce and combined with the piano thanks to John Cage who welcomed an entire soundscape of the outside.

The piece that is known for the development of the prepared piano is *Bacchanale*. Cage created a piano table preparation for this piece which consists of tone, material, string, and

distance. Thus, Cage explains how the tone should be performed, how the material should be placed in the strings, and solves the distance from the damper (Ferreira 2010). By providing instructions on how these devices should be placed into the instrument helps performers save time and have a better understanding of the score.

PIANO PREPARATION

TONE	MATERIAL	STRING (left to right)	DISTANCE FROM DAMPER
	small bolt	2-3	circa 3"
	weather stripping *	1-2	**
	screw with nuts & weather stripping*	2-3 1-2	** **
	weather stripping *	1-2	**
	weather stripping *	1-2	**
	weather stripping *	1-2	**
	weather stripping *	1-2	**
	weather stripping *	1-2	**
	weather stripping *	1-2	**
	weather stripping *	1-2	**

*fibrous

**Determine position and size of mutes by experiment.

Example 2: Table of Preparations of *Bacchanale* (New York: C.F. Peters 1960).

After some years, Cage composed the other piece known as *Sonatas and Interludes* performing an extreme level of preparation. Cage seems to suggest that, instead of being a single set of pieces, he finds the *Sonatas and Interludes* to be a cyclic whole only by being the result of repetitive variations of the same compositional processes (Perry 2005). Also, for this group of pieces Cage creates different piano table preparation by inventing different kinds of modifications in the piano's intonation, timbre, and response.

TONE	MATERIAL	STRINGS LEFT TO RIGHT	DISTANCE FROM BRIDGE (INCHES)	MATERIAL	STRINGS LEFT TO RIGHT	DISTANCE FROM BRIDGE (INCHES)	MATERIAL	STRINGS LEFT TO RIGHT	DISTANCE FROM BRIDGE (INCHES)	TONE
				SCREW	2-3	1 1/4"				A
				MED. BOLT	2-3	1 3/8"				G
				SCREW	2-3	1 7/8"				F
				SCREW	2-3	1 1/2"				E
				SCREW	2-3	1 3/4"				D
				SM. BOLT	2-3	2"				C
				SCREW	2-3	1 5/8"				B
				FURNITURE BOLT	2-3	2 1/8"				A
				SCREW	2-3	2 1/4"				G
				SCREW	2-3	2 3/8"				F
				MED. BOLT	2-3	2 3/4"				E
				SCREW	2-3	2 7/8"				D
				SCREW	2-3	3"				C
				SCREW	2-3	3 1/8"				B
				SCREW	2-3	3 1/4"				A
				SCREW	2-3	3 1/2"				G
				SCREW	2-3	3 3/4"				F
				SCREW	2-3	3 7/8"				E
				SCREW	2-3	4"				D
				SCREW	2-3	4 1/8"				C
				SCREW	2-3	4 1/4"				B
				SCREW	2-3	4 1/2"				A
				SCREW	2-3	4 3/4"				G
				SCREW	2-3	4 7/8"				F
				SCREW	2-3	5"				E
				SCREW	2-3	5 1/8"				D
				SCREW	2-3	5 1/4"				C
				SCREW	2-3	5 1/2"				B
				SCREW	2-3	5 3/4"				A
				SCREW	2-3	5 7/8"				G
				SCREW	2-3	6"				F
				SCREW	2-3	6 1/8"				E
				SCREW	2-3	6 1/4"				D
				SCREW	2-3	6 1/2"				C
				SCREW	2-3	6 3/4"				B
				SCREW	2-3	6 7/8"				A
				SCREW	2-3	7"				G
				SCREW	2-3	7 1/8"				F
				SCREW	2-3	7 1/4"				E
				SCREW	2-3	7 1/2"				D
				SCREW	2-3	7 3/4"				C
				SCREW	2-3	7 7/8"				B
				SCREW	2-3	8"				A
				SCREW	2-3	8 1/8"				G
				SCREW	2-3	8 1/4"				F
				SCREW	2-3	8 1/2"				E
				SCREW	2-3	8 3/4"				D
				SCREW	2-3	8 7/8"				C
				SCREW	2-3	9"				B
				SCREW	2-3	9 1/8"				A
				SCREW	2-3	9 1/4"				G
				SCREW	2-3	9 1/2"				F
				SCREW	2-3	9 3/4"				E
				SCREW	2-3	9 7/8"				D
				SCREW	2-3	10"				C
				SCREW	2-3	10 1/8"				B
				SCREW	2-3	10 1/4"				A
				SCREW	2-3	10 1/2"				G
				SCREW	2-3	10 3/4"				F
				SCREW	2-3	10 7/8"				E
				SCREW	2-3	11"				D
				SCREW	2-3	11 1/8"				C
				SCREW	2-3	11 1/4"				B
				SCREW	2-3	11 1/2"				A
				SCREW	2-3	11 3/4"				G
				SCREW	2-3	11 7/8"				F
				SCREW	2-3	12"				E

*MEASURE FROM BRIDGE.

Example 3: Table of Preparations of *Sonatas and Interlude* (Cage Published by E.Peters)

Electro-Acoustic Music

Fixed Media

The development of electroacoustic music is one of the main improvements in the music field and yet its working methods are little known outside its own immediate area and can lack general recognition as a consequence. A fixed (prerecorded) soundtrack is known to mean fixed media. This group will traditionally cover works for instruments and 'tape'. Today, set sounds are transmitted more often from the hard drive of a computer or a CD (Pestova 2009). Unlike the old types of equipment, with the developing technology, nowadays laptops and any kind of mechanism that has a playback feature can be useful. The musician must perform alongside a set recording of a modified or a reproduced sound while playing with fixed media (Loke 2017). To sum up, this method of music implication related to a prerecorded soundtrack is a one-way interaction when recording alongside the performer.

“Synchronisms No.6” Mario Davidovsky

Mario Davidovsky was a well-known musician, best known for his electronic music work. For his Synchronism No. 6 for piano and tape, he was awarded the Pulitzer Prize in 1971 (Lundgren 2020). The jury at the Festival claimed that the piece demonstrated the mastery and innovative use of a new medium in conjunction with the solo pianoforte (Hohenberg 1997). This piece is a very iconic example of the collaboration of fixed media and pianist.

"Synchronisms No. 6" prefigured digital developments in immersive electronics. It appears like the tape is adjusting to the live piano most of the time (The New York Times 2019). This piece is part of a series of compositions that merged conventional musical components with electronically synthesized sounds.

With a high-quality stereo playback device using speakers located next to the piano, Davidovsky developed an innovative interaction between the piano and synthesized tape sounds (Feng 2018). To sum up, his contribution to contemporary music opened up new views in chamber music by connecting live acoustic instruments with electronics.

The image displays a musical score for "Synchronisms No. 6" by Davidovsky. It consists of two systems of staves. The top system features a single treble clef staff with a piano part and a corresponding electronic part. The piano part includes a section with a dense cross-hatched texture, marked with a fortissimo (ffff) dynamic. The electronic part consists of vertical stems with flags, also marked with ffff, and includes some notes with accents and slurs. The bottom system features a grand staff with a treble clef and a bass clef. The piano part includes a section with a dense cross-hatched texture, marked with a fortissimo (ffff) dynamic, and a section with a dense cross-hatched texture, marked with a fortissimo (ffff) dynamic. The electronic part consists of vertical stems with flags, marked with a fortissimo (ffff) dynamic, and includes some notes with accents and slurs. The score is written in a complex, contemporary style with various dynamics and articulations.

Example 4: "Synchronisms No.6" Notation

Live Electronics

During the 1960s, the word "live-electronics" came into use to describe electronic music played in real-time, away from the electronic studio, in a concert setting with live musicians producing sounds through synthesizers, ring modulators, and other electronic instruments (Montague 1991). There is no assumption, that the musician creates traditional musical sounds in live electronic performances. In reality, the sounds were all electronic in their early days and performances also allowed for improvisation (Landy 2007). Moreover, the combination of live

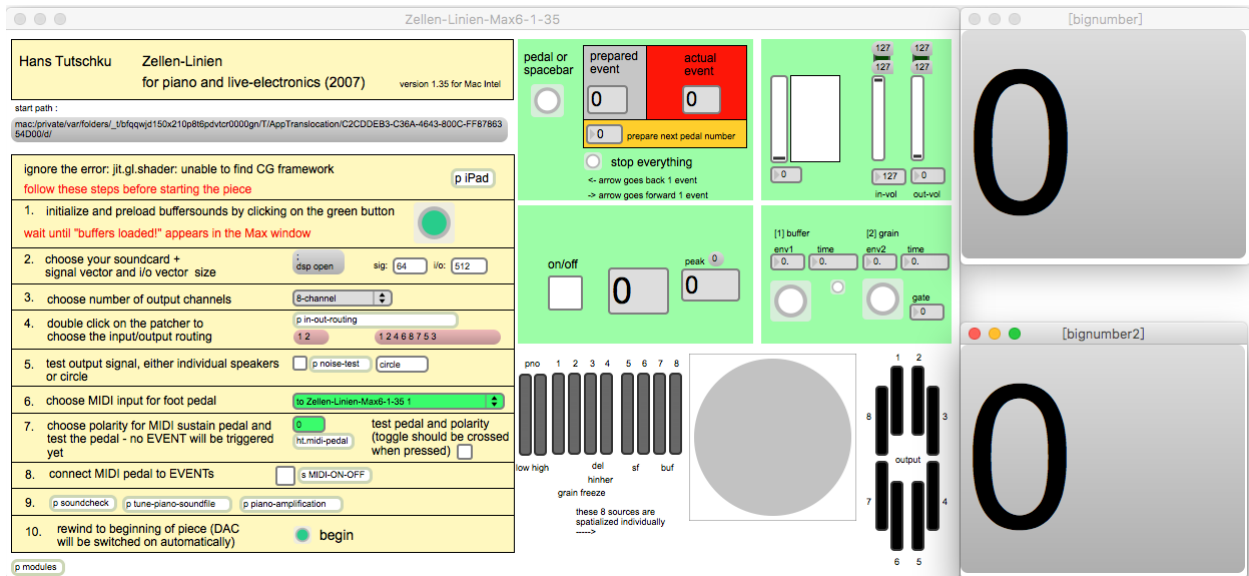
electronics with an acoustic instrument such as a piano makes an enhanced and more powerful instrument when those sounds melt into each.

Live electronic performing circumstances vary from fixed media works by offering an ability for the composer and performer to break the strict framework and in each performance to make the electronic and instrumental sections of the piece sound distinct (McNutt 2003). To illuminate, fixed media has boundaries. It will sound the same for every performance. On the other hand, live-electronics has the same approach of performing instruments because it has also a performance feature. This makes music spicier when combined with the instruments.

Cooperation in live electronic music can be compared to interaction between performers in traditional chamber music. The ensemble pianist has to be able to follow the conductor or other musicians. He or she may often appear in a solo role, needed to direct and guide others. Such similarities may be helpful for the artist to consider his or her role in the live electronics repertoire and to utilize any of his or her current abilities.

***“Zellen-Linien”* Hans Tutschku**

In the world of mixed music for instruments and live electronics, Hans Tutschku is an influential composer. One of the representative works of Hans Tutschkus' mixed music can be used as *Zellen-Linien* for solo piano and live-electronics. The original idea of *Zellen-Linien*, according to Tutschku, was to create the sound of a prepared piano without involving any physical exercise in the instrument (Tutschku 2020). To detect the amplitude of the piano, the composer planned to use the microphones installed within the instrument to activate the electronic sounds through the real-time computer audio processing environment Max (Wen 2018). Max is a very famous and common program that dominates the contemporary music industry. It has powerful documentation and coding that enables anything possible.



Example 5: Performance interface of *Zellen-Linien*

To produce the sounds for the live electronics section, Tutschku uses a number of preparation methods. To both analyze and produce sounds, a resonance model using FOF (Fonction d'onde formantique) synthesis is used (Wen 2018). In order to analyze and refine pre-recorded piano phrases, the composer used this approach and then layered and incorporated these resulting sounds into a range of vertical sonorities (Tutschku 2020). In a piece using live electronics, the form of interaction determines the relation between instruments and electronics. Furthermore, the features of the acoustic instrument (for example the timbre, the dynamic characteristics, the pitch range, the envelope of the amplitude, etc.) will also determine the essence of the interactive process.

Merging of Extended Techniques and Electronics

As mentioned before, the extended techniques are used to imitate electronic sounds. The technique of plucking and muting the piano strings are used to mimic the electronic effect while combining the acoustic and electronic sounds (Feng 2018). To clarify electronic sounds are

sonically related to the piano string alterations. The most common technological devices that are used to create a piano with electronic music are MIDI Keyboard and Synthesizers.

MIDI keyboard

MIDI (Musical Instrument Digital Interface) is a specification of a digital music application communication scheme (Loy 1985). It is a protocol that enables communication between computers, musical instruments, and other hardware (Landr 2020). MIDI was designed to connect synthesizers so they could share information such as the gestures of the performers. Many different roles are performed by MIDI: instrument control, control surface communication, lighting control, and time code sync. Any of these uses the standard MIDI format, but with specific features that differ (McGuire 2019). As it can be seen that midi is a set of information and can communicate with any device that has MIDI information. With the usage of MIDI, it is possible to trigger any audio file, light and musical or non-musical elements which are nowadays very popular among composers who work interdisciplinary.

This digital interface makes performers happy for being a musical networking standard device, and on the other hand, it has some limitations such as limited frequency and time resolution, limited access to synthesizer parameters for such things as timbre modification during synthesis, and lack of more than one direction in communication (Loy 1985). MIDI is used as replacements for acoustic instruments in traditional performance and in ensembles. As a method is essential in the theory of music and composition courses (Pan 2001). This is an undeniable fact to teach and learn the usage of midi which has a huge impact on producing and combining the sound of the piano.

Like all other devices, MIDI is part of the extended techniques which has a great impact on improving and expanding the limits of musical language and piano sonority. With this

method, the sonic range of piano is extended and changed the perspective of the compositional approach.

Synthesizers

Synthesizer is a traditionally computerized electronic system for sound generation and sound control (Dunwell 2020). This device is the closest imitation to the full-sized piano and compared with the MIDI keyboard is larger in the size. Synthesizers produce electrical signals that are translated to sound by a medium, such as speakers or headphones, traditionally in the form of a keyboard (Green 2013). Synthesizers have their own speaker and in order to make music, they are able to generate their own unique sounds and do not rely on an external interface or software (Dunwell 2020). Even though synthesizers have their own sound, they cannot create another sound besides the one that is already programmed in the device. Comparing with the MIDI keyboard it is more expensive and has fewer features.

A revolution in the idea of contemporary music has also been brought about, a revolution that can be found in nearly every form of modern electronic music. The conceptual shift made to music by the synthesizer since its development was an emphasis on the sound itself (Théberge 1997). The impact that the synthesizer had on music at the time of its development is much greater than imagined. The instrument clearly introduced a whole universe of alternative sounds to be used in a given composition.

Conclusion

With the information provided, piano extended techniques, the relationship with electronic music practices, and the examples of new techniques are explored with musical scores. The given knowledge will help the pianists to perform and have a better understanding of contemporary music. The list of techniques that are provided and their implication from

influential pieces of contemporary music history clarified the performance practice. Moreover, the relationship between electronic music and performance is thoroughly discovered for the pianists who are newly starting contemporary music performances. The notation of both extended techniques and electronic music is explored. The technical features of electronic music are examined including the concert setup and the collaboration. This paper aimed to be an updated version of guidance for contemporary performers. As technology improves each day, the music world will be affected by the developments.

Hence, as the developments of technology affect the recent compositions, notation and instrumentation techniques will be more complicated each day. However, this is not an obstacle to update new techniques for instrumentalists in the future. Therefore, teaching contemporary music as part of the music education curriculum in conservatoires from earlier ages as the other periods of classical music would help musicians to have a better understanding of the field and be familiar with the extended techniques.

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