

Evolution and Expansion of Sound: A Literature Review of Extended String Techniques
and Notation

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Abstract

The purpose of this literature review is to thoroughly discover the extended viola techniques and the adaptation of electronic music techniques into the sounds of the viola. This connection is crucial for every performer to learn. This relation helps to reveal the purpose behind the usage of the extended techniques. Thus, if the instrumentalist plays the contemporary pieces under the knowledge of the relationship between electronic music and extended techniques, the result of the performances sound better and closer to the sonic world of the composer.

Two problems will be discovered through the paper. Firstly, the performance of the extended techniques is problematic to instrumentalist who newly started to play contemporary music or to one who does not know how it should sound. To solve this, an extensive list of extended techniques and notation examples will be discussed with the help of the influential contemporary music scores, various orchestration, and new music instrumentation books. Secondly, the relationship between electronic music and acoustic music is a mostly unknown area for the performers. Exploration of electro-acoustic music types with the collaboration of acoustic music and the 1960's tape music techniques will be helpful to understand how both universes hold together and how electronic music techniques played an important role in the development of extended string techniques. The audience of this paper is violists, instrumentalists, and composers.

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Evolution and Expansion of Sound: A Literature Review of Extended String Techniques and Notation

CHAPTER 1: INTRODUCTION

This literature review thoroughly discovers the extended viola techniques and the adaptation of electronic music techniques into the sounds of the string instruments. This connection is crucial for every performer to learn. The noise orchestras embraced by Dadaist composers expanded the sound range of the pieces by implementing non-musical items into the music. This approach evolved to electro-acoustic music which led composers and performers to find out new sonic opportunities on the instruments (Vincent, 2003). The relation between electronic music and string instruments helps to reveal the purpose behind the usage of the extended techniques. Thus, if the instrumentalist plays the contemporary pieces under the knowledge of the relationship between electronic music and extended techniques, especially knowing where they came from, the result of the performances sound better and closer to the sonic world of the composer.

Two problems will be discovered through the paper. Firstly, the performance of the extended techniques is problematic to instrumentalist who newly started to play contemporary music or to one who does not know how it should sound. Also, performers stand far from contemporary music and the extended techniques due to the fact that these techniques are not a part of education system in traditional conservatoires and they were not integrated into the regular instrumental system. This is partially owing to an implicit resistance in the conservatories to contemporary music, and a leaning to treat it as inaccessible and complex (Knox 2019).

To solve this, an extensive list of extended techniques and notation examples will be discussed with the help of the famous contemporary music scores, various orchestration, and new music instrumentation books. Secondly, the relationship between electronic music and acoustic music is a mostly unknown area for the performers. Exploration of electro-acoustic music types with the collaboration of acoustic music and the 1960's tape music techniques will be helpful to understand how both universes hold together and how electronic music techniques played an important role in the development of extended string techniques.

The purpose of this paper aims to help performers to build a relationship between written notation and how it should sound by clarifying the 60's tape music techniques and its effect on acoustic music writing in order to explore the performance practice of electro-acoustic music with instrumentalists. String and electro-acoustic techniques divided into right-hand, left-hand, electronically aided or modified instrument, tape music techniques, fixed media, live-electronics and mixed media. Therefore, the connotations and the effect of electro-acoustic music on the string techniques will be discovered which will help to clarify the usage of the extended techniques and how they should sound.

CHAPTER 2: EXTENDED STRING TECHNIQUES

Discussion of extended techniques begins with the acoustic instrument itself. Three important string techniques are presented in this section: left-hand techniques, right-hand techniques and modification of the instrument.

2.1.Right-Hand Techniques

Right hand techniques are categorized according to the usage of the bow playing. The location of the bow vertically, horizontally or even drawing some certain shapes like "S" or "O" with the bow affects the sound generation. Moreover, the way of playing the bow such as usage of

the wood-stick of the bow or the change of articulations play a big role on creating different sonic events.

2.1.1. “Besides the bridge” Sul Ponticello

Unlike the normal playing place between bridge and the fingerboard, this indicates playing closer to the bridge which generates bright and powerful overtones. The precise place indicators stay same such as poco pont and molto pont (Arditti 2013). The method of playing sul ponticello, which simply means on the bridge. However, the word in action can indicate playing next to the bridge or just on the bridge. There is more string pressure as one performs closer to the bridge, emphasizing the higher overtones that are perceived as part of the sound pitch. There are several various styles of sul ponticello. “Using a fast light bow brings us to think about using an appropriate bow grip. This stroke works best with light fingers, not too far apart on the bow and perhaps experimenting with holding the bow nearer the tips of the fingers.” (Knox 2009) There is a risk of the bow sliding on the opposite side of the bridge and making a scratchy tone while practicing sul ponticello or even normal bowing as a starting string player. Sul ponticello is the best technique to bring out overtone content of the pitch.

2.1.2. “Ghosts” Sul tasto

Sul tasto defines as 'on the touch' and is a specific way to play over the edge or even right above the fingerboard with the bow. Knox also refers that this technique has very little adjustments in posture and no vibrato, so the player should experiment with releasing the head as far as possible and with the left hand bearing the weight of the viola. Breathing sounds can also be followed by genuine breathing (Knox 2009). Sul tasto, molto sul tasto also refers to playing over the fingerboard and playing nearly to the middle of fingerboard (Sekulic 2020). This technique is very

useful and effective to give the mysterious feeling. Unlike the sul ponticello technique, here the sound cuts off the high frequencies and has a denser volume on the lower aspect of the sound.

2.1.3. S.N.

Indicates normal sound. This is used after the one of the following indications: sound generated on the bridge, on the fingerboard while hitting, half-sliding or sliding the bowstick, etc (Porta 1985).

2.1.4. Bartok Pizzicato

Bartok pizzicato is produced by a powerful pluck of the string that string hits to the fingerboard (Strange 2001). The technique named after the composer's the modified way of the typical pizzicato the usage. It can be seen in the example below.



Bela Bartok String Quartet No.4 Bartok Pizzicato

2.1.5. Battuto

The bow should strike to the strings, not bowed. This generates short and percussive sound. (Arditti 2013)

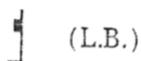
2.1.6. Tratto

Revokes the indication of battuto. Tratto is played as bowed. (Arditti 2013)

2.1.7 Col legno

The performer should use the wood part of the bow. For this, the bow should be turned round. This technique can be both used to generate sound either by playing bowed (*tratto*) or struck (*battuto*). Also, the mixture of both half *tratto* half *crini* (half bow and half hair) can be a possibility to play. (Arditti 2013) This technique is very useful with combining air noise generated by wind instruments when played as *tratto*. It has an accumulation and the flow inside of the sound. On the other hand, when played as *battuto*, this time the sound has a more fragmatic structure. Due to a totally sensible reasons to hit a \$10,000 bow to a \$40,000 instrument, the technique is often hesitated upon by instrumentalists! Luckily, only for this reason, most contemporary string players bring a less costly bow. (Strange 2001) Thus, as it can be understood that it is important not to neglect the instruments of the performer can be very valuable as fragile.

2.1.8 More Graphic Indications



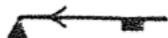
(L.B.)

: Hit the stick of the bow towards the strings (Porta 1985).



(L.S.)

: Slide the stick of the bow on the strings (Porta 1985).



: On the different strokes, shift the bow steadily and unnoticeable towards the tip (Porta 1985).



: On the different strokes, shift the bow steadily and unnoticeable towards the nut (Porta 1985).



: Do not pull the bow (Porta 1985).



: Apply a continuous pressure to the bow on the string (Porta 1985).



: Generate continuous over pressured sound, it is also called scratch tone (Sekulic 2020). This one and the previous one are the same indicators with different visuals.



: The pressure of the bow is increasing and reaches over pressured sound (Sekulic 2020).

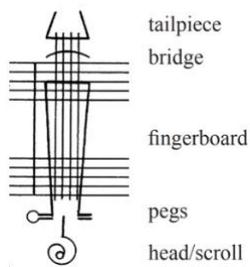


: The pressure of the bow is decreasing from over pressure to normal (Sekulic 2020).

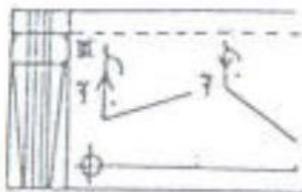


: The pressure of the bow gradually increases from normal to over pressured sound and decreases back to normal (Sekulic 2020).

2.1.9 The “Bridge Clef”



: This is called “bridge clef”. It schematically visualizes the front side of the instrument within the range of tailpiece to pegs (Lachmenmann 1971). This clef can be used to locate for anything within the indicated range such as bow position, finger position and their motion through time.



Helmut Lachenmann Gran Torso

The picture above is an example of the bridge clef usage. When this clef is used, in addition to the normal horizontal bowing form, other directions are often called for bowing the string. Because the horizontal playing of the music refers to chronological development, with oblique lines, the bow changes from bridge to fingerboard are noted.

2.1.10 Lachenmann's Bow Directions



: irregular motion, draw a shape an eight figure or a treble-clef (Lachenmann 1980)



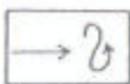
: irregular motion in circular form (Lachenmann 1980).



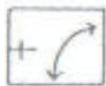
: Oblique motion played as back and forth. This is very similar the motion of windshield-wiper (Lachenmann 1980).



: Upright motion played as forwards and backwards (Lachenmann 1980).



: The arrow indicated that performer should gradually merge into the technique which is previously clarified (Lachenmann 1980).



: Unlike the others this symbol does not cancel previous motion but only increases it.

Within the limitations of the indicated motion, this symbol enables the performer some amount of improvisatory creativity (Lachenmann 1980)

2.2 Left-hand techniques

Left hand techniques provide changes on timbre and pitch. Important techniques used most commonly in contemporary compositions are investigated below that affect rhythm, pitch and timbre.

2.2.1 Microtones

Microtones are the notes between twelve-tone equal temperament (Strange. 2001) Below indications are common accidentals used by composers such as Simon Steen Anderson, George Friedrich Haas. The chart that is given below has 1/8 tone system. This also includes quarter tone system as well.

$n k \mu L m | \hat{A}$: 0, +25, +50, +75, +100, +125, +150 cents

$n K B j b J l$: 0, -25, -50, -75, -100, -125, 150 cents

$\uparrow \uparrow \triangle$: As high as it can (Lachenmann 1980). Highest note possible (Anderson 2004).

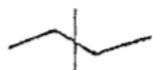
Generally played at the end of the fingerboard.

2.2.2 “One finger” glissando

One finger is a study of moving. As the title One Finger indicates, rather than moving between two separate fingers, it is an exploration of moving with one finger. All four fingers are used, but between one particular finger, the glissandi normally occur. Knox claims “Glissando

teaches the hand how to always be in playing position in relation to the string, and the fingers can learn a great economy of movement by this technique. It is also useful to experiment on how to hold the viola during these slides.” (Knox 2009)

2.2.3 Vibration



: Senza vibrato, means no vibration (Porta 1985).



: Apply small amount of vibrato with small oscillation (Porta 1985).



: Apply broad vibrato with broad oscillation (Porta 1985).



: Apply fast vibrato with little oscillation (Porta 1985).



: Apply fast vibrato with wide oscillation (Porta 1985).



: Increase the amount of width and velocity (Porta 1985).



: Decrease the amount of width and velocity (Porta 1985).

2.2.4 More Graphic Indicators



or



or



: These notations indicate

accelerando which means the rhythmical passage is getting faster (Porta 1985).



or



: Both notation indicates ritardando

which means the rhythmical passage is getting slower (Sekulic, 2020)



: Begins with a ritardando and continues with an accelerando (Porta 1985).



or



: Begins with an accelerando and continues with a

ritardando (Sekulic, 2020).



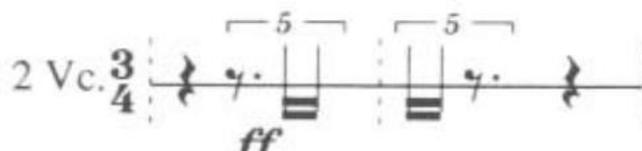
: Indicates the performance of irregular rhythms (Porta 1985).



: Damp the strings with left hand and stop the sound generation (Lachenmann 1980).

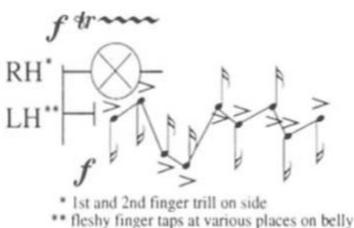


: Stop damping and release the left hand (Lachenmann 1980).



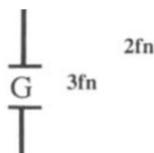
K. Penderecki, *Anaklasis*

Some composers also use left hand fingers as a percussive instrument. Left hand can generate both pitched or a non-pitched sound. After the implication strings can be damped or let vibrate. The composer may also suggest when all four strings or a selected few are to be struck by the performer (Vincent 2003). For example, K. Penderecki used finger slap technique in his piece *Anaklasis*. Rubbing the finger over the violin 's body is another potential example of the use of fingertips. By placing some rosin on the finger (to improve friction) and then rolling it over the wood, a roll may be accomplished. It sounds similar like a tambourine roll or fingered drum (Strange 2001). These small and iterative sounds can easily combine with percussive sound that are generated with other instruments.



Daniel Wyman, *Shadow Nos*

By offering an important contrast to the sounds created by the flesh of the fingertips, the use of fingernails extends the timbral potential once again. Due to the acoustic improvement of the high partials, which are best facilitated by the hard surface of the nail to create a sharper percussive tone. The techniques of the fingertips and fingernails can be used as same also including tremolo and tapping.



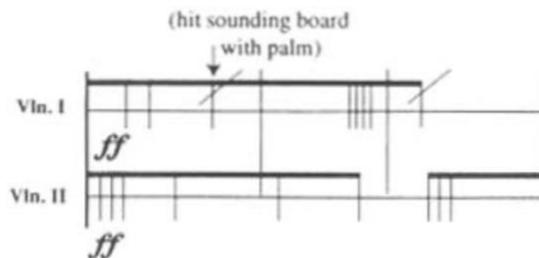
Kenneth Gaburo, *Antiphony*

The use of the knuckles is probably the most evident and normal use of the hand performing as a mallet. Knocking on a door is almost as efficient as knocking the body of the instrument.



David Cope, *Angel's Camp II*

The palm slap is the strongest of all the 'hand as mallet' methods. It is effective because, while preventing the instrumentalist from destroying the instrument, the musician will produce a loud percussive sound when the energy of the palm is not guided to a small point, but rather uniformly spread to a wider surface region (Vincent 2003). This technique generally combined with other percussive sounds generated by string section with similar writing or the rest of the ensemble to create a soundscape of iterative sounds.



K. Penderecki, *String Quartet No. 1*

2.3 Modification of Instruments/Notation

Modifications on instrument are very effective to change and extended the sonic range of the instrument. The most common devices that are used to manipulate the sound are scordatura, mics, paper clips, bow preparation, live processing with max, etc... Besides, notation is bending

from its traditional form to more conventional way. Here the modification on both instrument and the notation will be discovered.

2.3.1 Scordatura

Modification of the instrument's tuning either by changing the pitch of a single string or all strings (Arditti 2013). This technique is very effective to manipulate the nearly memorized timbral content of the string instruments. The term "scordatura" means the instrument's retuning to another standard rather than the one currently used (Russell 1938). Unlike the standard tuning system, which is widely known among the community, scordatura unlocks the doors of a whole new sound world and countless of different timbral possibilities.

2.3.2 Tablature notation

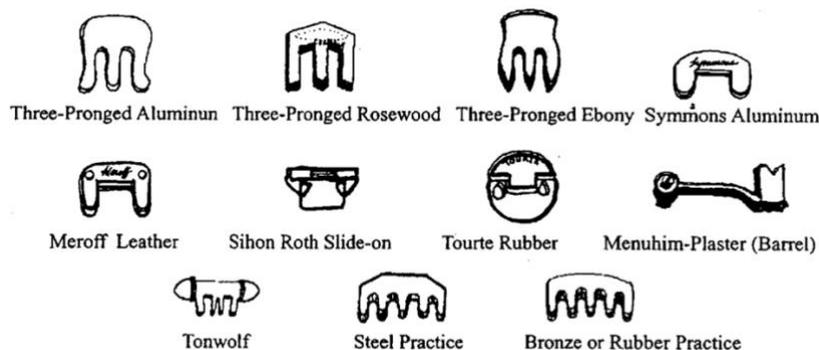
The most important thing about tablature notation is that it gives the instruction of making the sound instead of giving how it will sound. The technique comes from 14th century notation of organ and lute music (Arditti 2013). This system is very clear and has visual representation of the playing techniques. Helmut Lachenmann updated the historical notation into string writing. It can be seen examples from A. Cassidy.

The image displays a page of a musical score for a string quartet, titled "string quartet (2002)" by Aaron Cassidy. The score is arranged in a system of four instruments: Violin 1, Violin 2, Viola, and Cello. Each instrument part is written on a grand staff, with the right hand on the upper staff and the left hand on the lower staff. The notation includes various musical symbols such as notes, rests, and dynamic markings (e.g., *ppp*). The page is numbered with "72" and "96" at the top, indicating the page number and the rehearsal mark. The copyright notice at the bottom reads "Copyright 2001-02 Aaron Cassidy All Rights Reserved".

Aaron Cassidy String Quartet

2.3.3 Mutes

The most basic preparation for strings is obviously the mutes. Mutes have different shapes, sizes and materials which majorly change the sonority of the instrument (Strange 2011). Depending the variables of the mutes, the sound can be muted all the way or just slightly makes the sound less and soft. The demonstration of different mutes can be seen below. For instance, Simon Steen Anderson let violin and cello part to play with metal mute (practice mute) through piece in his music “AMID”.



Mutes (Strange 2011)

2.3.4 Body preparation

Thanks to John Cage who opened the doors of string preparation. It is possible to prepare the string instruments with the same ideology. Putting a wire or paper clip can enhance the overtones or filters the sound of the string (Strange 2011). This is an important decision to make about where the attachments should be located because it plays a vital role on the modification of the sound. Due to these attachments will produce some amount of buzz, the bow pressure can control how much or how less it should be.

The other preparation method which is different than putting items on the body of the instrument is the amplification. The microphoned instrument can make it possible to produce inaudible sounds audible. Moreover, with the help of computers and audio interfaces, it is possible to prepare a collection of sound process that manipulates the sound source at the same time (Strange 2011). This method is also used in live-electronic performance and mixed media as well.

2.3.5 Midi bow

The MIDI bow is a technique that has improved the string instrument its sonic arsenal, and optical arsenal. While standard MIDI violins projected the fingerboard and bridge to transmit data to a computer, the midi bow was to focus on the bow, which is not only acoustically the natural sound processing unit, but also in continuous motion as an entity, making it much more appropriate for MIDI control through a set of motion, speed and pressure sensors (Veltheim 2018) Because the bow uses midi data, it makes it possible to trigger any sound, light or midi compatible device. Sensors are used to understand the location of the bow and convert this data to midi which helps to make a correlation between movement and the triggers object.

CHAPTER 3: ELECTRONIC MUSIC

Electronic music played a vital role on the acoustic music composition regarding the search of new sonorities and playing techniques. It is important for instrumentalists to learn the 60's tape music techniques to make a relationship with both the notation on the score and the collaboration with electronics while performing.

3.1 Historical Tape Music Techniques

The history of electronic music in a smaller context starts with tape music. This history appears to be divided into three major eras; the early (now classical) era, which continued from the industrial invention of the tape recorder shortly after the Second World War until around 1960, the second era, which included the invention of electronic music synthesizers and the recognition as a valid compositional practice of the electronic device; and the third era, where computers dominated the field and achieved to become a center of the attention (Britannica 2020).

The concern is the compositional techniques during the first era and there is one name who had a vital impact on compositional techniques at that time, Pierre Schaeffer. He is a French composer, electronics engineer, and acoustician who introduced the term *musique concrète* with his team at Radio-diffusion et Television Francaise in 1948 which means the natural and original sound, animate or inanimate, are captured and modified so that the natural sounds are altered and blend in a musical style (Sinclair 2011).

The methods of alteration include adjusting the playback speed to modify the frequency, spinning the tape *visa-versa*, cutting the tape to practice exact duration control, cutting out or enhancing some frequencies of sound waves, and several other sophisticated manipulations (Sacic 2016). These techniques are started to be used with the foundation of tape music and continued and evolved until today. These days those techniques are still be in use such as DAW and even acoustic music compositions.

3.2 Fixed Medium

In listening terms, compositions which are entirely acoustic usually stand as fixed media audio records, unlike musical compositions which are created strictly utilizing sheet music (Glosbe

2020). Fixed media means a collection of pre-recorded sounds. This will typically involve pieces for instruments and 'tape'. Currently, fixed sounds are regenerated often from a CD or a computer (Pestova 2009). Performing with fixed media obligates the performer to play with a fixed recorded or altered real or synthesized sound.

This style is very secure to use because the electronic part is already recorded and there is no chance that it can stop in the middle of the concert. The only struggle is synchronization with the electronics while performing with the acoustic instrument. Due to the fact that electronic part has a fixed timeline, the events should be memorized, or performer should be supported with some sort of visuals.

3.3 Live-Electronics

This is worth remembering that circumstances of the live electronic performance vary from fixed media works by allowing the composer and the performer an ability to avoid the possible inflexibility of precise coordination and in each performance to make the electronic and instrumental sections of the work sound distinct (McNutt 2003). In the 1960s, in a concert environment of live musicians creating sounds by synthesizers, ring modulators, and many electronic devices, the term 'live-electronics' is used to identify electronic music performed in real-time, away from the electronic studio (Montague 1991). Thus, the concert experience made by live-electronics is more unpredicted when compared with fixed media. The excitement of the flexibility and the performative aspect makes the concert unique.

There is no implication, for live electronic music, that the artist creates conventional instrumental sounds. Thus, its early times, the sounds were mostly artificial, and improvisation was always enabled by performances. The notion persisted for decades that many other electronic musicians were either studio musicians or performer-composers in stage electronics, not to refer

instrument designers. This difference is likely to depletion eventually, with the already-faster machines and processors, but it is not quite entered that point yet. (Landy 2007) Although ability to perform during the stage is very exciting, there is also a risk to take. Because the live-electronic concerts depend on computer CPU and the technical capabilities, there can always be an issue such as freezing or stopping the audio in the middle of the concert.

3.4 Mixed Music

This is an in-between class that juxtaposes the practice of both approaches. Mixed music blends electroacoustic music and acoustic instrumental music (Boutard, Guastavino 2012). When interactivity is involved, the technical processes taking place are different, not least because the actor will lead the interaction, while he or she is typically guided by a pre-recorded "tape part" in a mixed instrument plus fixed medium output, mixed real-time works take a similar process in terms of listening perception as mentioned above. These works may sound like any kind of sound organization; consistency is far more in the form of a statement than in the sound of a provided matter in terms of the objective of this chapter of discovering forms of coherence. In terms of material and listening experience, it is the balance of the sources of the genre and where it sits along the mixed genre axis that determines the location of a given success job (Landy 2007). These interactions makes every concert sounds different. However the overall complexity makes the performance harder for instrumentalists beside it makes is nearly impossible for performing the same piece in different places.

CHAPTER 4: CONCLUSION

The effects of electronic music to the notation and sound search are explored regarding new viola techniques and how electronic music and acoustic instruments communicate in the

concept of stage environment. The solutions for the struggle that instrumentalists are facing such as, unaware of the sound that they generate and why, are given in the literature review. The history and the relationship between the interplay of acoustic and electronic music are clarified. Thus, it is helpful for instrumentalists to understand the extended techniques which are written in the performance instruction of pieces are not just some symbols but a helpful way to generate the sound world.

On the other hand, due to the fact that the performance of acoustic instruments with electronic music is no longer a mysterious box regarding what are the electronic music styles and the technology used during the performance. The issues of the communication with electronic music during the performance are clarified. The collaboration between acoustic and electronic music is discovered in terms of fixed, live, and mixed media. Thus, the communication with electronics and acoustic instruments and the technical issues are covered.

Therefore, the two issues which are the aim of the extended techniques regarding their ideal sound and the collaboration of electronic and acoustic music in the stage are defined. This research is current by now but due to the technology changes over years, the sound world of composers and their technical need will also change and become more complex.

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