구성적 음악 창작: 컴퓨터 기반 전자적 음악 프로덕션 상에서 샘플링의 과정과 효과

Constructive music creation: the process and effectiveness of sampling in computer-based electronic music production

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요약

컴퓨터에서 생성되는 전자적 음악의 심미적 가치에 관한 논란 속에서도 지난 십년간 음악 기술의 발전은 음악 작곡에 있어 가상 전자 악기와 샘플러 사용의 확산을 가져왔다. 컴퓨터 기반 음악 제작 플랫폼은 현재 일부 작곡가들에게는 표준이 되었을 뿐만 아니라 중요한 음악 저작 도구가 되었다. 컴퓨터 기반 음악 제작에서의 샘플링을 활용한 작곡 과정에 있어 두 가지 중요한 부분이 있는데, 그것은 이미 녹음된 오디오 샘플을 담고 있는 상용화된 샘플 라이브러리와 이 샘플을 처리하는 음악 프로덕션 소프트웨어이다. 이 연구는 컴퓨터 음악 프로덕션 소프트웨어 상에서의 주요한 샘플링 기능을 활용한 재구성적 음악 작곡 과정과 효과를 조사하여 분석하는 것을 목적으로 한다. 이 연구의 주안점은 오디오 샘플링 정의, 음악 작곡 과정에서의 샘플링 적용 방식, 음악 프로덕션 소프트웨어의 어떤 기능이 음악적 표현에 특정하게 유용한가에 초점이 맞추어져 있으며, 전자 또는 어쿠스틱 음악인들의 음악 창작 요구에 부응하는 연구 결과가 될 것으로 기대한다.

▌중심어 : | 전자음악 | 뮤직테크놀로지 | 샘플링 | 미디시퀀싱 |

Abstract

In spite of controversial debates on aesthetic issues of computer-generated electronic music, rapid advancement of music technologies in the past decade have resulted proliferation of using virtual software synthesizers and samplers in music composition. Computer-based music production platform has become not only a norm among some of contemporary music composers but also vital apparatus for their compositional process. There are two imperative parts of this compositional process involving sampling in computer-based music production, which are commercially available sample libraries that include pre-recorded audio samples, and music production software that processes them. The purpose of this study is to investigate the process and effectiveness of reconstructive compositional process utilizing distinctive features of sampling on computer music production software. This study addresses issues such as: the definition of audio sampling, how sampling is incorporated in compositional process, and what features of music production software are particularly effective in various musical expressions. The result of this study will hopefully accommodate and fulfill the needs of electronic and acoustic musicians' creativeness.

▌keyword : | Music Technology | MIDI Sequencing | Digital Audio Sampling | Loop Sampling | Electric Music Production |

I. Introduction

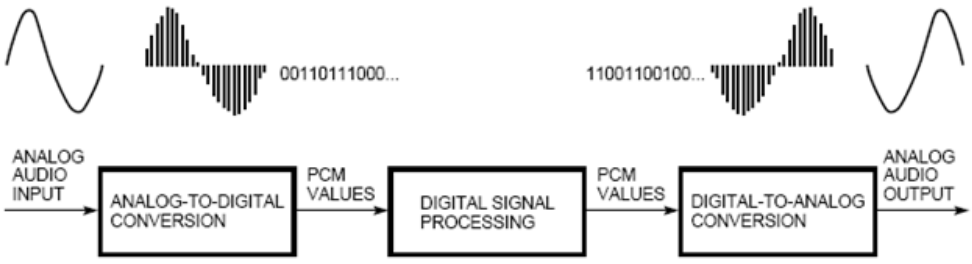
In current trends of music production process, digital audio technology is pervasively

implemented and became a norm for both music creation and consumption; Music as an art form of sound is created and transferred to listeners in digital domain based on digital audio sampling. This technology significantly affected and re-established relationship between music creators, mediators, and consumers. Furthermore, in the aspect of composition, the sampling technology also transformed the paradigm of music production rather significantly and controversially. Particularly, the versatile feature of non-destructive editing digital audio data has demonstrated new course and possibility for composition techniques, which led to new music genres. As combining with computer technology evolving in rapid speed, the sampling technology serves an important role in new music production process which tends to reduce or even eliminate live performance of musical instruments, and massively employs music computer software and hardware in the music production process. The technology is being widely implemented in various music genres and embraced by numerous composers, producers and performers even if it raises divisive arguments regarding aesthetic and ethical issues over music creation.

Ⅱ. Digital Audio Sampling

Sampling is a digital representation of electrical analogue audio signal or fluctuation which is fundamental technology of digital audio today. Whereas an analogue audio signal is a continuous fluctuation of electric voltage which can be monitored by an oscilloscope as a waveform, digital audio data consists of series of binary numbers which signify the values of the analogue signal at a particular moment in time, (Russ, 2004, p. 48). Samples are smallest segments of digitally converted numeric values of digital audio signal at a particular time, which are produced by analog-to-digital (A/D) conversion. This method is identified as "discrete time sampling", which distinguishes from an analog audio system. Samples are data of binary numbers, not any actual shape of signal, which represent the value of an audio waveform at a specific instant of time (Pohlmann, 2005, p. 21). Russ (2004) describes the analog-to-digital sampling process as having three stages as: "The audio signal is 'sampled'; the sample value is converted to a number; the number is presented at an output port", and he also describes the opposite process, digital-to-analog conversion, or 'sample replay' which also has three phases as: "The number is presented to an input port; the number is converted to an analogue value; the analogue value forms part of an audio signal" (p. 48).

In the aspects of composition and music production process, sampling is often used to assimilate acoustic instruments sounds for its realism. Sampling can be categorized into two distinctive sampling methods; single event note or "one-shot" sampling and phrase or loop sampling. Single event sample includes only a note of certain musical instrument's sound or a hit of percussion sounds such as a piano note or



▶▶ Figure 1 Digital Audio Conversion

a snare hit meanwhile phrase sample, also called as a loop sample, consists of patterns of multiple note events such as a rhythm phrase of drum performance, a saxophone improvisation phrase or even a full-length song. Samplers - whether in the form of computer software or external hardware synthesizers - operate by playing back previously recorded digital sound to allocated pitch regions (Williams & Webster, 2006). Samplers reproduce sound depending on the keys played by a performer, which is the playback of digitally recorded sounds – samples - of a single note or a part of phrase played by an instrument such as the trumpet, cymbal crash, a spoken vocal phrase, or a drum loop (Aikin, 2008). In the case of sampling a grand piano, all the sounds of 88 keys are digitally recorded at the various velocities of playing notes and then the multi-velocity samples of recorded each note are assigned to keys of piano by different pitch, which is defined as "Multisampling" (Aikin, 2007). Phrase or loop-sampling is frequently used for drum performances because the realism is highly convincing. Drum samplers not only reproduce the replicated well – known sounds of brand drum sets but also electrically perform the preset "grooves and patterns" – the loops – of actual drum performances (Aikin, Anderton, Fortner, Krogh & Rideout, 2008).

Ⅲ. Electronic Music Production

A typical workflow of music creation process involves utilizing music production software such as Steinberg Cubase, Emagic Logic Pro, Reason and so forth, which enables musicians to virtually realize performance of acoustic or electronic instruments; to process digital loop samples; to record live performance of musical instrument; and to mix recorded audio materials. As the title of specification indicates, music production software allows musicians to create music without the need for involving other audio hardware because the music production software is typically equipped with all necessary features and functions to create music. This type of software was initially named as "MIDI Sequencer" for a basic MIDI processing functionality; however, it has evolved along with rapid development of personal computer technology, and became capable of processing digital audio as well. The music production software is best facilitated for realization of compositional ideas, implementing artificial MIDI performance or pre-recorded sample loop without human performance of musical instruments. This progressive method is contracting with traditional notion of compositional process in Western art music which is identified as "work[ing] their [composers'] ideas into written scores" (McCutchan, 1999, p. xi). Composers concretize their musical abstract into graphical notation in order for performers to decode, interpret and perform it before an audience. In other words, the compositional process is creating a "musical code" for performer to sound which completes the very process of music creation that is inevitable. In the attempt of conceptualizing compositional process, as a graphical symbolization of musical abstracts, in theoretical or hypothetical models, many researchers agreed that it is excessively complex to be accurately illustrated and elusive to be conceptualized. Consequently, composition is specified as a score preparation process in pragmatic aspects and passed on until some pioneers of electronic music demonstrated new direction and methodology in composition implementing digital audio sampling technique.

Using segments of pre-recorded audio without instrument performance for composition was first experimented by an early electro-acoustic music composer, Pierre Schaeffer in 1948 (Katz, 2004).

The experimental genre was called "Musique Concrete" that consists of non-musical natural sound for music composition. Schaeffer introduced a composition, Etude aux chemins de fer, only using natural sound recordings. The sounds were recorded at the depot for the Garedes Batignolles, Paris, which consisted of the sounds of six steam locomotives whistling, trains accelerating, and wagons passing over joints in the rails (Manning, 2004, p. 21). Schaeffer explored the possibility of new sonic texture by physically splicing and pasting audio tapes. He also discovered how varying the play back speed of the audio tapes could affect the pitch, over all duration of individual sounds, and their amplitude envelope. This methodology of facilitating manipulation of sound recordings became the initiation of sampling technique that is widely used today.

Ⅳ. Loop Sample Manipulation and Phrase Sampling

Sampling and loop sampling are variously defined in the aspects of composition and practicing music production. Digital audio sampling is "a digital process in which pre-recorded sounds are incorporated into the sonic fabric of a new song" (Demers, 2003). Loop samples are partial audio segments in length of usually one to four bars, which may be continuously repeated as many times as musically needed (Duffell, 2005, p. 14). "A loop is a sample of a performance that has been edited to repeat seamlessly when the audio file is played end to end." (Hawkins, 2004, p. 10).

The most distinctive advantage of implementing loop samples is the efficient capability of manipulating them without deterioration in audio quality. Particularly, Tempo and pitch of digitally sampled music can separately change in any increment with proper audio editing software, which was impossible before the digital audio technology came into practice. Due to the analog audio property on an electro-magnetic medium, tempo and pitch always had to be manipulated in conjunction with each other; if a piece of music on an analogue tape is played back at twice speed of its original tempo, then pitch of the music should be raised one octave higher. Time Stretching is the process of changing tempo of audio without altering pitch, while Pitch Shifting is, in contrast, changing pitch without altering tempo (Russ, 2004, p.208). Some other valuable features of manipulating edit digital audio are to reverse, cut, loop, layer, reverberation, amplitude change of desired frequencies within a sound, noise reduction of addition and so forth (Katz, 2004, p.139). These digital audio editing techniques such as particularly Time Stretching and Pitch Shifting significantly affected and changed the paradigm of music composition to an actual execution of musical ideas as a complete aural art, from graphical realization of musical abstracts for performance.

Music production software such as Steinberg Cubase 5 is capable of non-destructive audio editing which is for viewing and manipulating audio or loop sample by cutting and pasting, removing or drawing audio data, processing or applying sound effects; the original audio data is not altered in this process and will remain unmodified until actual commend is executed.

As incorporating multiple audio loop samples for music composition, there has been a major disadvantage which affects creative inspiration in a stressful or harmful way. The performance of each loop contains different time information which may conflict when matching up more than one loop samples. The loop samples in commercially available sample libraries today are produced to be accurate in tempo most of the time; however, they are, most likely, out of

synchronization after repeatedly playing back several times if they are not matched as precisely as in one hundredth of BPM, Beat per Minute. Many music software companies tried to solve this disadvantage over the decade. A few companies, Steinberg Cubase and Sequel, Sony Acid, Propellerhead Reason and Apple GarageBand, introduced and demonstrated new optimistic potential of manipulating pitch and tempo of loop samples in further advanced and convenient methods which may well preserve artistic inspiration.

▶▶ Figure 2. Steinberg Cubase Arrange Window

AudioWarp is an audio sample manipulation feature in Sample Editor of Cubase which can time stretch and pitch shift (Steinberg, 2009). The purpose of this function is to match the tempo of multiple sample loops to the central project tempo of Cubase so that they can be matched up each other and compatible to variable tempo as changed by transport or tempo track. The Musical mode is sub-feature of AudioWrap which permit to synchronize audio samples to the project tempo by using real-time automatic time stretching. Once it is applied to the loops, they will adapt to all various tempo changes just as MIDI note events while preserving timing nuance of performance. Hitpoint detection is another feature of the Sample Editor in Cubase for manually altering the grid and tempo of loop samples, which may be applied if the automatic function did not provide satisfactory results. Hitpoint function creates "slices" which represent individual "beat" event in a rhythmic loop samples through detecting "attack transients" in the loop samples and consequently adding a type of marker, i.e. a "hitpoint", at each transient. This function can provide such results as: changing the tempo without altering the pitch; extracting the tempo information from a drum loop for audio quantization; extracting or replacing individual sounds in a drum loop; and processing sound of each sliced audio events. Steinberg claims that this function works effectively with drum or other rhythmic loop samples.

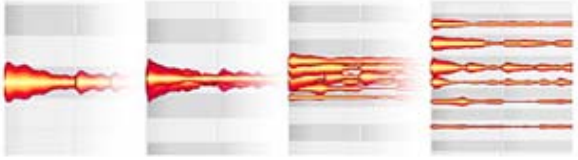
▶▶ Figure 3. Manual Grid Editing in Sample Editor

VariAudio is another feature in Cubase, which presents comprehensively incorporated pitch manipulation of each note in monophonic recordings. It is purposely developed for fixing intonation and timing defects of monophonic recording material such as vocal performance or wind and brass instruments. VariAudio analyzes audio data and divides into segments by note pitch events in the course of detection process and consequently the pitch and intonation of recognized audio events may be altered completely non-destructive in order for any modification to be undone and reverted back to the initial state.

The result of processing is fairly promising and unrecognizable which is vastly acceptable for a professional use.

▶▶ Figure 4. VariAudio Pitch Detection in Sample Editor

In the explosion of digital audio technology development, a music software company, Celemony, at the Frankfurt Musikmesse 2008, claimed and demonstrated Direct Note Access or DNA feature within Melodyne software, which is digital audio processing technology that enables to manipulate individual notes within polyphonic audio recordings (Celemony, 2008). Its main function is to separate each note in a mixed polyphonic audio data and to extract pitch and time information; Celemony claims that Melodyne's features of modifying pitch, timing, note lengths and other parameters of melodic notes are also compatible with individual notes within chords. This unique feature of DNA is not currently available in any other software and not possible before, which is the first of its kind in digital audio manipulation.



▶▶ Figure 5. Separation of Polyphonic Aduio Data

Celemony asserted that any particular notes in a polyphonic audio material such as a piano or guitar recordings may be modified as desired even if the notes are part of a chord. The recognized notes are graphically displayed as "blobs" in an editor or in conventional notation. As normal audio editing software would present, time is represented horizontally meanwhile pitch is represented vertically. Once polyphonic audio sample is separated, notes are then displayed spread out as note events of their own pitch. The effects of using DNA feature are correcting wrong pitch and timing within a chord; transform all or partial harmony; and transpose the chords to particular scale. The limitation is set to modifying individual instrument tracks in the course of a typical multi-track music production. The feature distinguished the audio data based on harmonic and temporal contexts, which detects notes only by pitch not by timbre of the instruments. It also provides audio-to-MIDI data conversion which can export MIDI data from the audio file to be used in scoring to print out; or outputting the MIDI data to be performed by other synthesizers.

V. Copyright and Sampling

While digital audio sampling has enabled musicians to utilize the enormous convenience of creating new music by incorporating digital samples, it has also caused controversial challenges to existing intellectual property right laws. Some musicians in certain genres such as hip-hop attempt to "sample" other musicians' performances right off the CDs even though numerous sample libraries are commercially available. This process may be considered as interchanging or borrowing the musical ideas of others; however, it poses some serious issues of plagiarism in the music industry, where the

phenomenon is highly controversial in relation to intellectual property law. Schumacher (1995) addresses the issue as individual authorship and creativity in the realm of capitalist social relations by presenting the philosophical stand-points and common law decisions regarding intellectual property. Furthermore Schumacher depicts the legal status of capturing sound as analyzed by Gaines (1991) - sound turns into copyrightable property with the status of a "protected property-appendage" when it is captured to grant the sound its "materiality" (p. 119) - and asserts that "sampling is a way of appropriating this property, of subverting the proprietary status of sound and allows for a new kind of poaching on the aural commons". Current trends in legal rulings on digital audio sampling constantly favor the owners of intellectual property which re-establishes "the relation of exteriority between producers and capital and secures the rights of the corporate legal subject over the concerns of cultural expression" (Schumacher, 1995).

Borrowing and referencing other's music is a traditional technique that has been practiced in music composition for centuries. Katz (2004) argues that if digital audio sampling is considered to be a form of musical borrowing, it then has features common with the traditional borrowing of musical works (p.139). He compares digital sampling with traditional borrowing in classical music, citing examples such as Renaissance masses based on the secular song "L'homme armé"; the borrowing of the chant "Diesirae—The Day of Wrath" by Berlioz, Liszt, Rachmaninoff, Saint-Saëns Ysaÿe in their instrumental works; Bach's borrowing from Vivaldi's musical ideas, and so on. He asserts the notion that sampling performance sound may also be beneficial in capturing the "aura surrounding the sound," including which are "the reverberation" and "constant ambient noise". Furthermore he states that "traditional musical quotations typically cite works; samples cite performances," and consequently suggests "performance quotation: quotation that recreates all the details of timbre and timing that evoke and identify a unique sound event" (p. 141). Regarding the radical speed of technology development in music, it can be assumed that it becomes more and more difficult - almost impossible - to detect the source of sampling even if one desires to uncover. Katz's suggestion above certainly seems to be a feasible solution for the sampling related to copyright; however, it will probably require a vast amount of effort from all who are concerned with copyright protection.

Ⅵ. Discussion

Digital audio editing technology and commercial sample library for loop-based music production are adequately developed today. In addition constructive music creation is pervasively in practice among professional and amateur musicians and composers because results of loop-based composition are effective and efficient particularly in music production of T.V. drama, movies and multimedia. The superb quality of performance and sound in commercially available loop samples resulted in decreasing demand for live acoustic instrument recording while increasing productivity. Some music software technology is remarkably capable of manipulating loop samples to create better performance parts for composition which is difficult for an audience, or sometimes even for professional musicians, to distinguish the artificiality . In fact, general public is widely exposed to listening to music with some degree of artificial performance in daily life. Software introduced in this article can be fairly easy to operate if a user has some knowledge in basic music technology and music. It is a safe

assumption that various software companies are doing the best to make the knowledge to be learned easier and faster as well. Adoptability and accessibility of music technology certainly concern vast majority of musicians, particularly performers and conservative critiques. Some musicians, particularly percussionists, may feel as if they are being replaced by the loop samples. Even using artificial electronic rhythmic patterns in a composition became a trend in certain genres, which many composers simply prefer using them for convenience and unique sonic texture. Some critiques opting for more conventional way of music consumption object the idea of implementing technology because they believe in music as a performing art which should be performed by musicians in front of an audience.

The technology has certainly reached to the extent to fulfill the needs of whoever desires to compose or create music. Music creation process will be likely to evolve to be enormously accessible so that every one can create music with some knowledge of operating software as the digital computer technology is being constantly developed. In spite of controversial concerns, the future of music technology will be advanced far superior so as the implementation, adoptability and accessibility. It is my believe that there will be more musicians who embrace and appreciate the technology for music than who rejects the idea. Technology adoption is beneficial for all musicians in both creative music work and music consumption whether they acknowledge it or not.

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