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ABSTRACT

Computers are ubiquitous in the process of music recording and distribution, and increasingly also in the process of music composition and performance. This tool has a considerable effect on the music itself, especially when the computer is pressed into service in the actual role of performer or composer. Since music is assumed to be a form of human emotional expression, one may wonder how a computer can effectively contribute to its creation and performance. What can a computer have to "say" in music? By taking a look at its use and influence in Korean music, we see some examples of how the technology affects musical content.

INTRODUCTION

Ever since Marshall McLuhan's famous remark that "the medium is the message"[1] there has been increased awareness of the relationship between media and content. In the mid-1990s, amid the boom of new media and new media technologies (cable TV, CD-ROMs, DVDs, the Web, etc.), the term "content provider" was coined. The new forms of communication did not have enough immediate content to communicate, so a commercial opportunity appeared for anyone capable of providing content that would fill the empty space or time in the media. "Content" has become a product in its own right, essentially regardless of the content's content. The English word has been adopted as a word in Korean media vocabulary, as well (*keontencheu*).

As media theorists point out, these communication technologies are not neutral, but have a shaping influence on their content. Even the computer, which might appear to be an undefined tool until it has been programmed, encourages certain kinds of content and discourages others because the content providers, visual designers, and designers of user interfaces must use software designed by others. In this article I will restrict my considerations to music made with computers, in some cases with the computer assuming

a primary role, and I will look at some specific examples of Korean music made with computers.

Computers in Everday Musical Experience

Computers are pervasive in music today—in its recording, production, distribution, performance, and composition. The process that is currently used for recording music is to convert the electrical signal received from a microphone into a series of millions of binary numbers that represent the sound wave in digital form in computer memory. The most common means of listening to music, the compact disc player, is a special purpose computer for converting those binary digits (encoded on the disc) into voltages that drive loudspeakers. Recent advances in numerical encoding and data compression have resulted in the MP3 storage format, which requires about one tenth the memory of compact disc recordings, allowing sound files to be moved quickly and easily over the internet and stored on small playback devices the size of one's finger. Even people who attend many live concert performances still hear the vast majority of their music in the form of digital recordings played through loudspeakers. (One study found that people who have not often attended classical music performances prefer the sound of a violin coming from loudspeakers to a the sound of a real violin.) So even in this banal sense, digital sound has become the norm, and live instrumental music is the minority.

In the recording studio, the sound is edited, enhanced, and error-corrected in post-production, such that—depending on how radically the producer has elected to modify the sound—the recording almost invariably contains sound that never existed, and indeed often could not have existed, in non-digital form. Even in classical music recordings, where the engineer's goal is usually to make the sound modifications sufficiently subtle that our attention is not attracted to them, digital effects such as filtering, dynamic compression, spectral enhancement, and reverberation are routinely applied. Some recording purists still travel to record in a particular stone church to get exactly the reverberant sound quality they desire, but in the vast majority of cases a computer-generated simulation of reverberation is simply added to the recording in post-production. This digitally simulated reverberation is so common that it has, like the sound of

loudspeakers, come to be considered the norm, and direct sound is considered weak and bland in comparison. In performances at the National Center for Korean Traditional Performing Arts, the instruments are amplified and digital reverberation is added in an effort to add power to the instruments and give an illusion of a more reverberant space. I believe that this is done not so much because the instruments are too weak to be heard in the space or because the hall has acoustical defects, but rather because that is the preferred sound of today, conforming to the norm set by digitally recorded music. In a more touristic setting such as the Jeong-dong Theatre's Korean music presentations, the reverberation and amplification are even more extreme, transforming the music from an intimate chamber experience to a forceful theatrical one.

In popular music recordings—less frequently in classical music—a rather ingenious digital processing technique of pitch correction is now routinely used to fix tuning errors by the singers. Although it's considered impolite to say aloud, this has the added commercial benefit that singing stars can now more easily be chosen for attributes other than their ability to sing in tune. This processing technique usually creates a characteristic electronic-sounding artifact that is fast becoming a new norm in popular music. I can easily imagine teen listeners who have grown up with this sound finding an unaltered singing voice to be inexplicably strange. Indeed, this subtly "electronified" vocal sound is particularly at home in popular styles that employ digital synthesizers and other computer electronics, ranging from R&B and hip-hop to overt electronica. These styles also feature computer-sequenced and synthesized drums, with real drummers increasingly relegated to rock and *indie* styles. The combination of computer-sequenced digital drums and synthesizers, digitally processed voice, and highly compressed dynamic level (the recording is processed in such a way as to be pretty much equally loud all the time) is most evident in Korean "dance" music. In this context, "dance" refers to music played for dancing in clubs, showing influences of other popular computer music genres such as house, techno, electronica, and Euro-disco. The way that certain artists use these computer characteristics with upbeat harmonies and vocals in Korean dance music results in a style that is qualitatively different from American and European music. The voices in many of these songs, while heavily processed with digital effects, are often the only elements that are not digitally generated and sequenced. In performances of her hit tune

"Ari Ari" this year, singer Jung-hyun Lee combines this style with costumes and movements that are clearly influenced by traditional Korean dance.[2] While this might be viewed as a superficial juxtaposition, it is a unique synthesis of old and new aspects of Korean culture and does result in a distinctive performance.

In the world of amateur musical amusement, *norae bang* (karaoke) systems use computer technology to combine digitally recorded and/or synthesized instrumental accompaniment, digitally synchronized video and text, added reverberation for the singer's voice, and—in higher end systems—even computer harmonization and realtime pitch correction of the incoming voice and responsive tempo following. Similarly, in a popular video arcade game a computer plays a digitally recorded music track and displays a synchronized animated graphic score of the desired drum notes. The game allows an aspiring drummer to play along with the music, striking drumpad controllers that trigger synthesized drum sounds, attempting to play precisely the rapidly scrolling notes designated onscreen. The computer is programmed to measure the time difference between the played notes and the notes in the score, and to give the user instant evaluative feedback—"perfect", "good", "fair", etc.—and a final grade (or an abrupt halt to the music and a failing grade in the case of a poor performance). This game requires the expense of a good many ₩500 coins in order to master even a single one of its many stored tunes. Of course the *norae bang* and video arcade technologies are not intended to create an artistic product, but they are a significant technological industry, require skilled programming and imaginative engineering, and are important elements in the cultural life of many young Koreans.

The point of the foregoing paragraphs is that, while they are not always in the foreground of our thoughts, computers are a simple fact of contemporary musical life. My intention is not to provide a comprehensive overview of computer usage in music, but simply to point out and review the extent to which computer technology affects practically every musical experience today. As in so many areas of our lives, computers in music are neither novel nor a fad, but already are firmly installed and here to stay. Korean universities, notably the Korean National University of Arts and Hanyang University,

offer graduate degrees in computer music, training students in the technologies and techniques of computers in music.

Computers in Academic Music

In academic circles the computer is being used in other ways for music. Some technical work is being done in universities to research new methods of sound generation. This is really engineering research that is essentially independent of its potential aesthetic usage, but such research often does find its way into new synthesizer designs and new compositions. One group of engineers at Hanyang University is collecting digital recordings of individual notes from many traditional Korean instruments, with the idea that these notes can then be triggered easily by a music keyboard or other interface. This is a well-established idea known as *sampling*, and is the basis of many commercial synthesizers that contain databases of samples of notes from different instruments. Commercial synthesizers, which are mostly from Japan and the U.S., rarely if ever contain samples of Korean instruments, though, so the group at Hanyang is aiming to fill that niche. Sampling synthesis has some well-known limitations, however, one of which is that the digital recordings of each note are unchanging and thus are too "perfect". In reality a human instrumental performer almost never plays any given note in the same way twice. Good musicians are constantly making subtle and not-so-subtle adjustments to every note that they play, based on the musical context. Sampling synthesizers that just trigger recorded sounds tend to lack sufficient capability for such nuance, and thus rarely succeed as truly convincing emulations of most instruments.

Another small consortium of technicians in Korea is considering the feasibility of creating software models of traditional Korean instruments using the technique of physical modeling. Physical modeling is an approach to emulating existing instruments that starts not with the instrument's sound but rather with its physical construction, using knowledge of physics to make mathematical formulae that describe the action and interaction of its component parts in response to the actions of the player. For example, a physical model of a geomun-go might begin with a basic formula describing a stretched string, which takes into account its material, mass, tension, and length to determine how

it will vibrate and create energy. But that is only the beginning, because every component of the physics of the entire instrument must be included in a fully descriptive formula. In the case of geomun-go this includes such factors as the sympathetic vibration of other strings, the resonant effect of the instrument body, the placement of the moveable bridges to affect the open string length, the placement of the left hand to change the length of the string in discrete steps, the continuous variation of pressure of the left hand to change the tension of the string, the material, mass, velocity, angle, and placement of the plectrum stick which creates a noise element when it strikes the string and/or the instrument body, and probably other things I've not recognized. Each of these factors must be figured into a very complicated physics equation, with constants for every immutable instrument characteristic and variables for each possible modification or performance trait.

Both of these methods of software synthesis of Korean instruments—sampling and physical modeling—require that the sounds be somehow triggered and controlled, i.e. performed. For realtime performance by a player, there must be a suitable physical interface that provides a high level of nuance and an appropriate gestural control. The characteristic sound of these instruments is closely tied to the manner in which they're played, so existing controllers such as music keyboards are not generally a satisfactory user interface for performance of a Korean instrument. A fully performable instrument therefore calls for design and construction of a new hardware controller that will permit nuanced and natural control of the sound-generator. That, too, is a complicated proposition, requiring capital for prototyping, labor of both mechanical and electrical engineers, and collaboration with knowledgeable musical consultants who are virtuosic players of the original instrument. If the new interface is too different from the original instrument, a player will need to invest years of practice to achieve a comparable level of mastery, so it's advisable to leverage the years of skill already developed by experienced players. Even if all of the hardware and software challenges are mastered, it's debatable how much will have been gained by creating a digital imitation of an acoustic instrument that already has many virtuoso performers and centuries of history, whether it be a Western oboe or a Korean sepiri.

Physical modeling is a topic of much current interest in the field of computer music engineering, and I understand the desire to apply the technology in ways that address uniquely Korean musical concerns. Sound synthesis research driven solely by engineers can be problematic, however. When there is not enough communication between artists and technicians, computer music research risks lacking sophistication in one area or the other. Ideally there should be input from both types of expert about what problems are worth pursuing and what are the requirements of the solution.

Another field of activity in university music departments is the composition of electro-acoustic music. The term "electro-acoustic music" has been coined in the academic music community to encompass both *musique concrète* (music that employs reconfigured recordings of acoustic sound sources) and synthesized sounds (electronically generated). It typically involves use of the computer as a versatile programmable synthesizer of unusual sounds and/or processor of recorded sounds. These new sounds are generated in software, without direct physical control by a performer, and the music is therefore intended to exist only as a recording.

Academic computer music is a subset of academic contemporary music, which is in turn a subset of contemporary classical music, which is a small subset of the classical music that is performed in concerts today. Within this small sub-subculture of academic contemporary music, computer musicians are generally ghettoized into separate academic programs and separate concerts focusing exclusively on electro-acoustic music. This appears to be equally true in America and Korea. Since most such music is for recorded media, these concerts are usually group-listening sessions for cognoscenti rather than actual performances, lacking the personal charisma and drama of live performers. Because most of the musical sound has been generated in software without physical performative gestures—by someone seated before a computer in a mode one writer has described as "office work"[3] as opposed to playing an instrument—it often lacks some of the expressive gestural qualities that are an important component of performed music. Because most of the practitioners have salaried professorial positions, they are not bound to produce commercially viable music. The concerts are poorly attended anyway, and are not generally put on as money-making enterprises, so commercial evaluation is not an

issue. And because of the separatist nature of such concerts, there is rarely much significant critical attention from the arts press. Even among the academic composers themselves, critical aesthetic writing is relatively scant. As a result, the composers and the music float in a fairly closed society relatively devoid of evaluative aesthetic discourse.

Academic computer music would thus seem to be quite a negligible cultural phenomenon outside the walls of academe. However, its practitioners are music educators who to some degree shape the aesthetics, interests, and knowledge of young musicians. Most Korean academic composers of contemporary classical music, particularly those who are interested in computer music, have traveled to Europe or the United States for at least some of their graduate education. There they learned and adopted the techniques and stylistic practices of Western academic computer music composers. The prevailing aesthetics of the teachers has strongly shaped the style of these students, who have returned to Korea, acquired academic posts in Korean universities, and are teaching what they have learned. This is not substantially different from the development of young American academic composers. However, the cycle of professor-composers training people who immediately become professor-composers—regardless of whether it be in Korea or America or Europe—has a conservatizing effect and tends merely to replicate established aesthetic thinking. If we add to that the fact that computer music requires a considerable time investment just to become conversant in the field, and requires ongoing technical study to keep up with the rapidly changing technology, it's easy to see how professors of computer music can become a bit isolated from the musical culture at large.

It's also apparent to me—as a composer, listener, and teacher—that the computer technology itself, and the orientation of those who develop the hardware and software, has a strong formative influence on the kind of music that gets produced with it. There is a symbiotic relationship (some might even call it a vicious cycle) between technology and art that is well known to theorists and to practitioners in computer arts. Technology is designed to accomplish a certain purpose, and the technology then shapes the way that that task is done, and—more importantly— serves to shape and define the nature of the task itself. The more that composers use the same computer tools, and the more those

tools shape the musical result, the more the music gets homogenized, tending toward an archetype that is established by the makers of the technology and by the dominant teachers in the field.

These are plausible explanations why much of the electro-acoustic music by Korean academic composers is not readily distinguishable from that of America or Europe. Most of it is for recorded media without live performers, uses technology developed mostly in the U.S., and shares many of the sounds, techniques, and stylistic traits of music by Western composers. Computer music composers become overly absorbed in the technical minutiae of digital sound synthesis, using software tools designed by engineers, and fall into sonic clichés based on what the software makes possible.

Now admittedly that is a gross oversimplification of the actual situation. A person's aesthetics are shaped by a full lifetime of experience, often by osmosis just as much as by education, and I'm not suggesting that Korean computer music composers somehow lose their native Korean culture when they study abroad, nor that stylistic traits are so easily classifiable. And I'm certainly not suggesting that Korean composers must meet a standard of Koreanness formulated out of some vague foreigner's notion of the culture. But as a member of the academic music community, I'm concerned by these factors I've just described, which I see in both America and Korea, and which I consider intra-culturally isolating and at the same time internationally homogenizing.

In the quest for interesting sounds for their compositions, some Korean composers of electro-acoustic music turn to the sounds of traditional Korean instruments. These instruments certainly are a rich source of interesting sounds, and—even for Korean composers—have a rather exotic connotation for those who have been trained strictly in European classical music. For example, in several of his electro-acoustic compositions, composer Hwang Sung-ho has mixed snippets of traditional instrumental sounds with electronically generated sounds to make a texture in which the two types of music may be mutually reflective.[4] In some pieces the instrumental sounds are divorced from their original musical context, while in others a direct reference is made to some traditional musical style.

A type of computer music that is just beginning to find practitioners in Korea is that in which a live performer "interacts" with a computer that has been programmed to produce sounds in real time. I'm personally a proponent of this approach to computer music, because I feel that the absence of performance, gesture, and virtuosity has contributed to a lack of expressivity in much computer music made directly for recorded media. Since this is my own area of interest and is in part responsible for my being in Korea at all, I will now discuss my own experience working on interactive computer music with the daegeum (Korean flute).

Exploring the Combination of Computers and Korean Instruments

For the past twenty years I have been interested in the challenge of programming a computer to be musically creative. Such efforts often involve research in artificial intelligence, but more generally fall under the rubric of *algorithmic* composition, meaning that the process of composition is formalized in detail so that it can be programmed into a computer. With the speed of modern processors, a computer can compose spontaneously and instantly—in other words, a computer can improvise. A good improviser must be a good listener, so in addition to programs for composing, an improvising computer must have some faculty of perception and cognition. It must be able to "hear" and in some way evaluate the sounds environment in which it is improvising. And to be truly *interactive*, the computer should not simply react slavishly to what it hears, but should contribute some "ideas" of its own that have not been deterministically programmed into it.

As I was working collaboratively with flutist/composer James Newton to design an interactive piece for flute and computer, he gave me recordings of flute music from various parts of the world that had strongly influenced his own playing—Japanese shakuhachi, Chinese dizu, Peuhl shepherd flutes, and others. He emphasized his interest in the potential of the computer to be a tool to broaden one's musical outlook toward other cultures and to synthesize musical styles and influences. Inspired by his artistry on the flute and by his words, I undertook to explore the combination of daegeum and computer.

I was not at all certain that any daegeum player would be interested in performing with a computer, nor that a traditional musician would be comfortable in a situation where s/he was required to improvise spontaneously with an unpredictable electronic partner. As a composer I was not at all certain even what an appropriate combination of those two might be, nor had I really any experience at all in composing for daegeum. But I was interested to see what musical and technical challenges this endeavor would present.

There are many characteristics of traditional Korean music that are fundamentally different from Western classical music. Of particular interest to me sonically as well as intellectually are the aspects of the music that are continuous and variable rather than discrete or constant. Pitch is perhaps the most obvious such musical parameter. In Western music the pitch of each note is relatively discrete and stable, both ideally and in practice. In Korean music the pitch fluctuates more widely during the course of a note, bending around or gliding within a pitch region. Certainly the discrete steps of a scale are active conceptually, but much of the expression and interest lies in the deviations from, or movement around, the discrete scale tones. Thus, it can be said that the pitch of a "note", the fundamental unit in music, is quite a different notion in Korean traditional music from European classical music.

This makes the task of computer cognition of the parameter of pitch more complicated in Korean music, for two reasons. The first reason is that computer programming languages themselves are fundamentally biased toward discrete distinctions, and are thus replete with functionality for enacting categorical logical distinctions. Any concept that involves ambiguity or fuzziness generally requires more complicated programming. The second reason is that the current orientation of the technology of pitch detection by computer is toward defining a single pitch for each note, following the Western concept of a note. The mathematical knowledge exists to understand notes as a more complex evolution of fluctuating pitch and energy, but most technicians have directed their efforts toward reducing that information to a single pitch. If we take that technology and naively apply it to, say, a daegeum or a haegeum, we often come up with a rather humorous misinterpretation. To "understand" these pitch fluctuations as meaningful—rather than as conceptual anomalies to be discarded—we need to retain the information and write

programs that can attempt to follow it, parse it, and use it to guide the computer's response.

Other musical parameters such as loudness (dynamic range) and tone color (timbre) are important in both Korean and European music, but in the case of the daegeum usually cover a much wider range of variability, especially within a single note. The sound of the daegeum may range from extremely soft to very loud many times within a single blown note, much more radically than most Western instruments. Thus, while most Western notes can quite easily be analyzed as having a beginning attack, a steady (or slowly decaying) state, and a release, a daegeum note often includes repeated dynamic fluctuations that are so wide as to risk being misinterpreted as separate notes by a simplistic computer detector. The construction of the daegeum includes a membrane (*cheong*) that vibrates more or less actively depending on the pitch and loudness of the note being played. The vibration of the cheong contributes a characteristic buzziness to the timbre of the daegeum, and the player can exercise considerable control in emphasizing or avoiding this buzziness for expressive effect. The timbre of the daegeum can therefore vary from a pure bamboo flute sound to a biting reedy sound akin to the *piri* (Korean oboe), or some combination of the two. This variation in timbre, similarly to the variation in amplitude, can occur over a wide range in the course of a single note or phrase, causing a radically different spectrum of energy in the computer's analysis.

So how is a computer to "understand" Korean daegeum music? It's apparent that the Western paradigm of a note as an entity with a single pitch, loudness, and timbre is not appropriate to this music. Therefore I have decided in my own composition largely to dispense with the perception of individual notes, and rather to capture and use the complex continuous shape of the changes occurring in each of these musical dimensions. In my program the computer evaluates the daegeum sound as time-varying functions of pitch and amplitude, and as a complex spectrum of changing energy at different frequencies within each sound. This at least gives the program more information that is potentially useful in emulating the expressive gestures within the player's sound.

And what kind of response might the computer make in a musical setting? How might one successfully combine the sound of a Korean instrument like the daegeum and the sound generated by the computer? The existing repertoire of synthetic digital sounds is mostly overtly electronic in character. We perceive sounds as being electronic particularly because they contain regularities that are inhuman and/or because they lack complexities and irregularities that are distinctly human. Generating such sounds, a computer sounds quite inexpressive in juxtaposition with a charismatic virtuosic human performer. My efforts in designing the computer's response to the daegeum focus on using the expressive shapes derived from the daegeum performance to shape and control the synthesized sounds. I don't try to avoid "inhuman" or "electronic" timbres per se, but I try always to imbue them with some of the lively character captured and extracted from the performer's sound.

The success of my effort in this particular piece will in some part be measured by the reaction of the daegeum players who encounter it. Will a person who plays it once want to play it again? Will other players who hear it performed be interested to add it to their repertoire? If not, it will become just another piece of electro-acoustic music, existing only on CD. So trying to make a piece like this is an experiment and a risk, but I think such efforts are needed in order to understand better how computers can successfully interact in performance with Korean instruments.

LOOKING FORWARD

I am interested to see how Korean musicians will integrate computers into their work to create original music that they feel is an effective expression of their ideas and their culture. As computer-based styles of music develop here—both popular and academic—I think it's helpful for music makers and their audience to be aware that much of the existing technology is not as neutral as it may seem. As I've attempted to demonstrate, computer software and synthesizer hardware is modeled on Western music criteria, and thus has a tendency to impose Western stylistic traits. The music one studies in America and Europe, while it has the ability to overwhelm Korean music for political and

economic reasons, is not inherently more cosmopolitan than the things one can learn from traditional Korean music.

In the academies, Western music and Korean music are treated as separate fields of study, and computer music is treated separately from both, as a bastard subset of Western music. I feel that a more integrated approach to music education would develop more fully educated musicians who would be able to address the complexity of modern Korean musical culture more readily.

I'm not suggesting that the music must simply include traditional Korean instrumental sounds, nor that composers must self-consciously employ Korean styles and forms. But if young musicians studying the use of computers in music will study Korean music, it can be a rich resource for developing a personal style that is stronger in character and ultimately more interesting and expressive.

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[1] Marshall McLuhan, *Understanding Media*, 1964.
[2] Lee Jung-hyun, *vol. 4 - I ♥ Natural*, 2002.
[3] David Zicarelli, "Music Technology as a Form of Parasite", *Proceedings of the International Computer Music Conference*, 1992.
[4] Hwang Sung-ho, "Contrast", *TV Scherzo*, 2000.