… Seine hohle Form… - Artistic Collaboration in an Interactive Dance and Music Performance Environment

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ABSTRACT

In this paper we outline some of the technical and aesthetic concerns involved when musicians and choreographers collaborate within the context of an interactive dance system. Issues of mapping are examined, focusing on the mapping of dance gesture to real-time synthesis parameters. Perceptual correlation of these mapping strategies is stressed, albeit through varying levels of abstraction. Finally, portions of the authors' interactive computer music/dance work "Seine hohle Form" are profiled as examples of the aesthetic and technical challenges faced when working with such systems.

Keywords

Dance, interactive dance system, gesture, interactive computer music

1. Introduction

The use of choreographic gesture as a control component in music composition/performance for dance has been a concern of choreographers and musicians for almost half a century. As electronic instrument builders of the 20th century struggled to devise unique interfaces for their unique instruments, choreographers such as Merce Cunningham offered the surprising option of extending the concept of gestural control to the world of dance. The Cage/Cunningham experiments of the 1960s using Theremin technology to sense body motion are only one example of this experiment that still continues today.

When musical control was relinquished to dance gesture, the union of open-air (non-contact) gesture to sound raised many intriguing questions. Even though the technology has progressed to the point where current dance systems rely on sophisticated video tracking instead of the antennae of a Theremin, the cause and effect relationship between sound and gesture has remained an elusive problem. Up to this day, most interactive dance/music systems have relied on fairly simple relationships between gesture and sound, such as the basic presence or absence of sound, volume control, possibly pitch control.

The lack of progress in this direction has been complicated by the tenuous threads of communication between the computer music and dance fields. Indeed, although much work has been done recently in the world of computer music by composers/performers developing and composing for gestural controllers, the world of dance has remained largely isolated from these developments.

Today's tools, however, provide the possibility of rich relationships between dance and music in interactive systems. Real-time software for music synthesis and digital signal processing (i.e., MAX/MSP, developed by Miller Puckette and David Zicarelli, and jMAX, developed at IRCAM) is readily available and runs on standard desktop and laptop PCs (Macintosh and PC LINUX). Likewise, comparable developments in video image tracking/processing as a source of gestural information (e.g. Palindrome's EyeCon system) have given composers and choreographers powerful tools with which to harness the expressive gestures of dance. But the lack of communication between the two fields, and the often-limited concept of what interaction actually means in such work has limited, in the authors' opinions, the expressive possibilities of the collaborative work.

Working alternately in Nürnberg, Germany, and Denton, Texas, Palindrome Inter-media Performance Group and the Center for Experimental Music and Intermedia (CEMI) have explored these issues in their ongoing work together. A body of interactive dance/computer music works is emerging, as well as a dance-

specific vocabulary of gesture mappings between movement-recognition and real-time digital sound synthesis.

2. Mapping

In an interactive system, sensors do the job of "translating" one form of energy into another. Specifically, the physical gestures of dance are translated via sensors of various sorts into a digital signal representation inside of a computer. One the gesture is available as an abstract amount of computer data, however, the important question arises: what do we do with it?

"Mapping" is the process of connecting one data port to another, somewhat like the early telephone operator patch bays. In our case mapping has a very specific connotation—it means the applying of gestural data, obtained via a sensor system, to the control of some sound synthesis parameter. The dramatic effectiveness of a dance, however, invariably depends on myriad factors—movement dynamics of body parts and torso, movement in space, location on stage, direction of focus, use of weight, muscle tension, and so on. And although sensors may be available to detect all of these parameters, there still remains the question of which ones to use in a given setting, and then to which of the equally many musical parameters to assign it.

Herein lies the basic quandary. Making these mapping choices, it turns out, is anything but trivial. Indeed, designing an interactive system is somewhat of a paradox: the system should have components (dance input, musical output) that are obviously autonomous, but which, at the same time, must show a degree of cause-and-effect that creates a "perceptual" interaction. Unless the mapping choices are made with considerable care, the musical composition and choreography can easily end up being slaves to the system. In some cases, interaction might not occur at all. Not in a technical sense—the movement will indeed control the music—but in the sense that no one (except perhaps the performers) will notice that anything is going on!

Some may argue that it doesn't matter whether or not an audience is aware that interaction is taking place. Even if the artist is completely alone in experiencing the interactivity, for some it may be enough that the system of interaction "privately" affects the performer's expression within the piece. The audience is only vicariously part of the interactive experience.

Palindrome Inter-Media Performance Group has not chosen approach. Instead, we have searched for a more effective—or at least more convincing—result. Two strategies seem reasonable. One is, as mentioned above, for the choreographer and composer to create their work specifically for a given technological system. Not, of course, that every dance gesture needs to trigger every musical event—there is actually considerable playroom in this regard. What Palindrome has learned is that even when only *part* of an interactive piece is clear and convincing, audiences will attune to and accept more complex relationships.

The second strategy, which does not exclude the first, entails more deliberate and targeted mapping strategies. This is in turn means identifying those qualities or parameters which are most fundamental to a piece—analyzing what information lies in the essential nature of the work. This is a more complicated, but rewarding approach, since it means that the technical system is born out of a need to serve the artistic vision, instead of the other way around. These mapping strategies should focus and harness the essential parameters of the movement, while acknowledging the perceptual aspects of human movement. A first step toward this approach might be to begin with the relationship of that which our eye sees, to that which we perceive when watching human bodies in motion.

3. Gestural Coherence

Just as is true of the sound world, we do not perceive the human body in motion in a very objective or scientific way. What we perceive in dance is highly filtered and often illusory--the choreographer and dancer work hard for this effect. Indeed, the quality of flow at one moment may dominate our perception of a phrase so much so that individual shapes of the body go unnoticed. At another moment, geometrical shapes may override our perception of movement in space, and so on. And of course the sound--particularly musical sound--has a powerful affect on how one perceives dance.

Our projects in Palindrome have explored these issues of perception and movement. In particular, we have concentrated on the notion of "gestural coherence"; that is, the perceptual coherence between sound and the movement that generates it. Within the context of this search for gestural coherence, we have made the following postulations:

- An emergent integrity arises when the relationship between the dance and music systems is "believable".
- Believability depends upon gestural coherence.
- Gestural coherence is achieved through a system of mapping that mediates the two parallel structural systems (musical and choreographic).
- Musical structure emerges from dance gesture through a schema that provides for a mixture of the following gesture-to-synthesis parameter mapping strategies:
  - one-to-one, or "direct" mapping
  - one-to-many, or "divergent" mapping
  - many-to-one, or "convergent" mapping

4. Application: "Seine hohle Form"

The words "seine hohle Form" are a fragment from the poem "Gesichter" by Rainer Maria Rilke, roughly translating to "its hollow form." As a starting point for this interactive work, premiered at CEMI in November 2000, the title words serve as an emblem for the interesting challenge of creating a musical work that only exists when a dancer moves, and a dance in which movement must be approached as both functional, music-creating gesture as well as expressive or decorative elements. The collaboration between music and dance on this piece was complete; that is, the movement and sound were not designed separately, but interactively. Indeed it could hardly have been otherwise.

The choreography is affected by the live generation of sound through the use of sensors and real-time synthesis, and the resulting music is in turn shaped by these movements. There are no musical cues for the dancers, since without their movements the music is either nonexistent, or at other times, missing key elements. This method of working forced not only an inherent degree of improvisation upon the group, but also prompted a sharing of artistic roles in the working process: dancer became musician, composer became choreographer...

"Seine hohle Form" is of course not the first interactive computer-controlled dance. As mentioned earlier, interactive dance has a long history, and recent important contributions include the work of David Rokeby, Troika Ranch, Antonio Camurri, among others. Our work may be unique, however, in the extent to which multi-dimensional mapping strategies have been used within a framework of gestural coherence.

4.1 Technique

In Palindrome works the dancers' gestures are tracked using the EyeCon video-tracking system, designed by Frieder Weiß of Palindrome. EyeCon is based on frame-grabbing technology, or the capturing of video images in the computer's memory. By frame-grabbing and processing a dancer's movements, it is essentially possible to convert their gestures into computer data that can then be mapped into control of music or other media. For "Seine hohle Form" we use three small video cameras set up above and diagonally in front of the stage.

The analysis features of the EyeCon video-tracking system include the following six movement parameters:

1. Changes in the presence or absence of a body part at a give position in space.

2. Movement dynamics, or amount of movement occurring within a defined field.

3. Position of the center of the body (or topmost, bottommost, left or rightmost part of the body) in horizontal or vertical space.

4. Relative positions (closeness to each other, etc.) of multiple dancers (using costume color-recognition).

5. Degree of right-left symmetry in the body--how similar in shape the two sides of body are.

6. Degree of expansion or contraction in the body.

While in theory these features may be combined in any way, in practice a maximum of two at one time seems to make sense; more, we have found, is simply not perceivable.

The real-time sound synthesis environment was designed in MAX/MSP by Butch Rovan. A PC running EyeCon is linked to a Macintosh PowerBook running MAX/MSP, sending the gestural data gathered by EyeCon to the real-time sound synthesis parameters. All mapping is accomplished within the MAX/MSP environment, and changes throughout the work. (fig. 1)

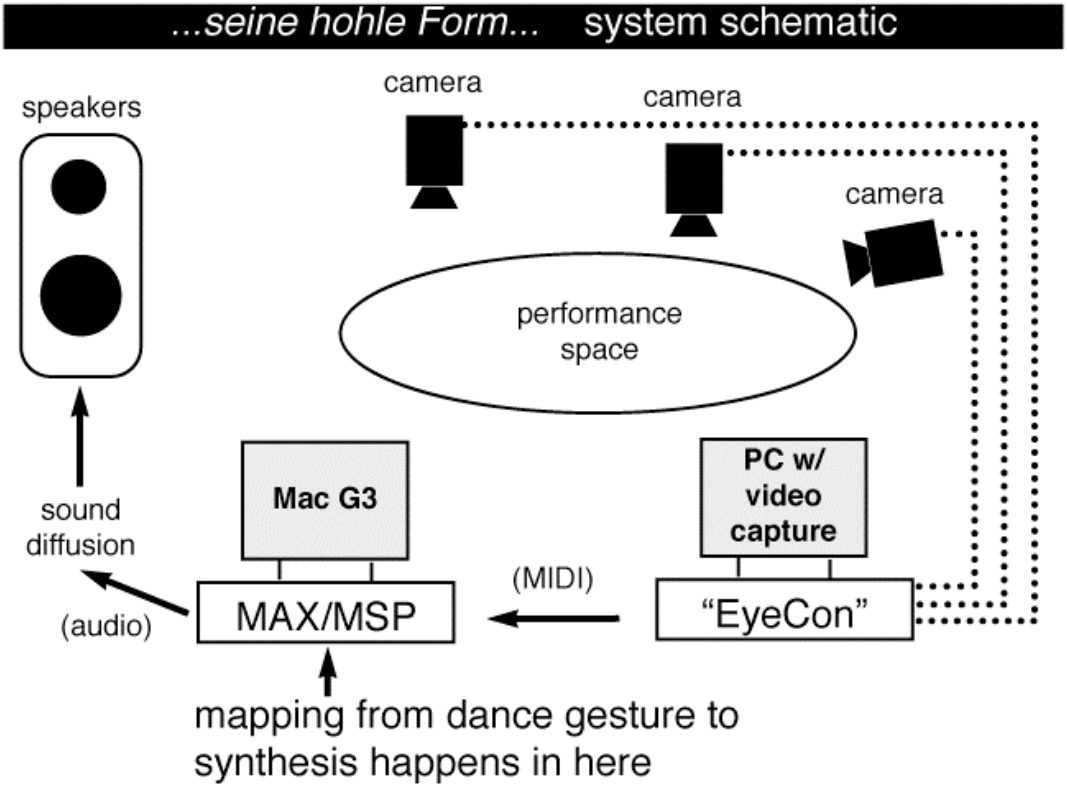

Figure 1: The real time sound System environment of … seine hohle form…

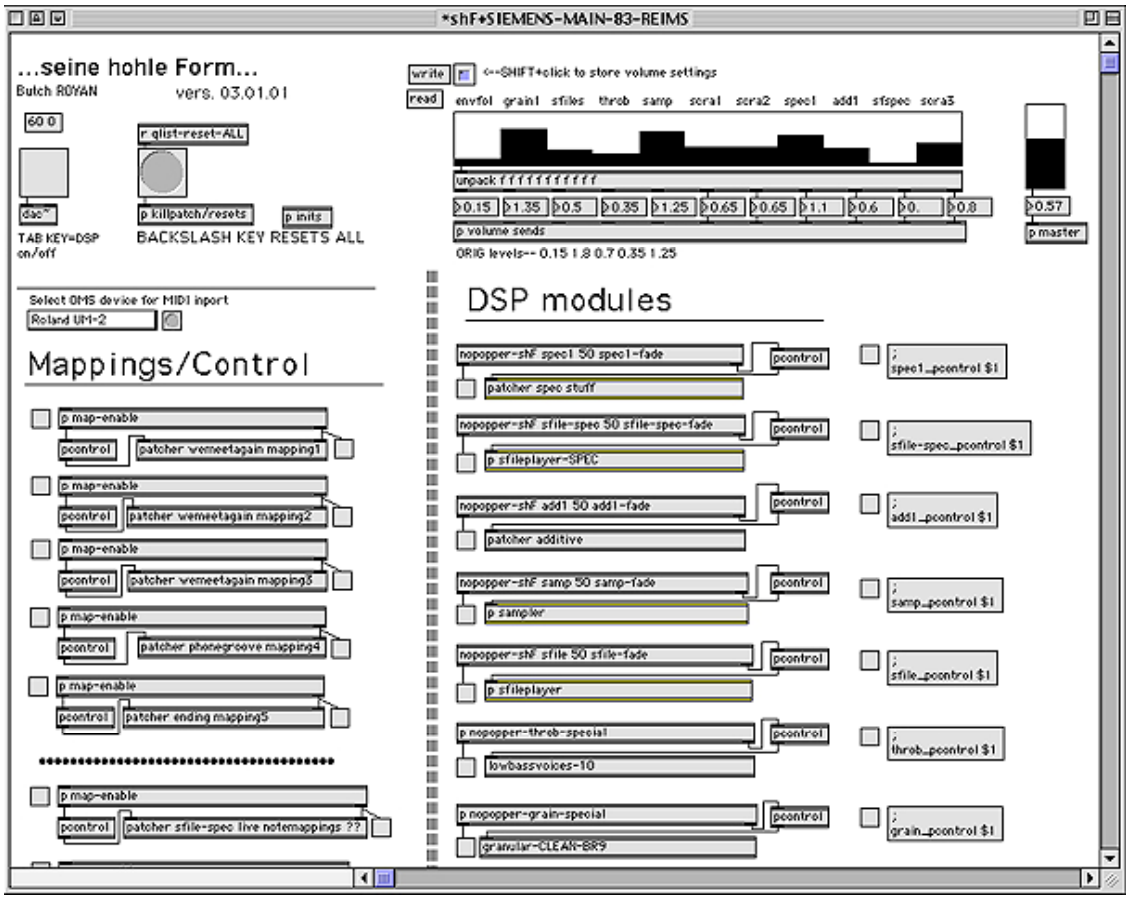

Figure 2: Custom-build DSP modules of … seine hohle form…

The MAX/MSP program for "Seine hohle Form", designed by Butch Rovan, is a musical synthesis environment that provides many control parameters, addressing a number of custom-built DSP modules that include granular sampling/synthesis, additive synthesis, spectral filtering, etc. (fig. 2)

Control of the musical score to "Seine hohle Form" is accomplished through a cue list that enables/disables different mapping and DSP modules. Both EyeCon and MAX/MSP software components are organized as a series of "scenes", which represent different configurations of video tracking, mapping, and DSP.

4.2 Examples from "Seine hohle Form"

The following description of excerpts from "Seine hohle Form" is certainly not complete; even within these few described scenes there is a good deal more going on. Nevertheless, it may offer an introduction to our working methods. (NOTE: a QuickTime movie excerpt of SHF is available at www.palindrome.de).

In scene number 5, the first dancer (female) controls nine relatively clear and isolated additive synthesis tones with the extension of her limbs into the space around her (an example of one-to-one mapping). An algorithm in MAX/MSP modifies the pitch and timbre slightly with each extension. Meanwhile, the second dancer (male), back to audience, uses small, whole-body movements to cut off quieter, "whiter" sounds which build continuously as long as he is not moving.

In scene number 1, the male dancer manipulates a stream of loud, aggressive sound fragments derived through granular sampling. He activates the sounds through equally aggressive side-to-side torso movements. The speed and velocity of his movements shape the parameters of the granular sampling engine continuously, with many interactions between incoming gesture parameters (an example of convergent mapping).

In scene number 3, the male dancer finally rises from his low stance and approaches the audience. Here, his height (highest body-part from floor) controls the parameters of a real-time spectral filter, producing a thinner and more continuous musical texture. The effect is much subtler and less direct than what has come before, and lends a sense of disorientation to his part, softening his role following the opening solo, and thus opening the way for the female dancer to begin her own solo.

5. Conclusions and Future Work

The basic technical system described in this paper has been operational for almost a year (and had been tested in performances in Munich, Dresden and, most recently at the 2001 conference of the Society for Electro-Acoustic Music in the United States in Baton Rouge, Louisiana). It has, however, become increasingly clear to us that our current process for gestural mapping could be improved by creating a clearer hierarchy among the parameters that govern relationship between the video-tracking system (EyeCon) and the sound synthesis software (MAX/MSP). In particular, we are working to segregate more clearly the tasks that are assigned to each component of the system.

Of course, making use of the inexhaustible mappings between movement and sound requires an understanding of the different and potentially conflicting-goals that drive composers and choreographers. In the past, traditional models of collaboration between composers and choreographers have subjugated either dance or music, or sidestepped the question altogether by removing all correlation between movement and sound. In a collaborative work such as "Seine hohle Form," a new opportunity exists, one that avoids this conflict entirely by making the work of choreographer and composer inter-dependent rather than dependent; fused instead of segregated.

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