

# Digital Preservation of New Media Art Through Exploration of Established Symbolic Representation Systems

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## ABSTRACT

In this paper, I describe my thesis research, which is concerned with digital preservation of new media art. This paper is divided into three sections: The first places technical digital preservation approaches within the context of artistic concerns; The second places digital variable media art within the context of other, more traditional variable art forms; and the third section describes my thesis project and methodology, which is an attempt to define the important characteristics of an existing art form (namely, music) through the exploration of users' annotations; and from that data, make some conjectures regarding the important elements of a new media art object.

## Categories and Subject Descriptors

H.5.1 [Multimedia Information Systems]: Animations; Artificial, augmented and virtual realities; audio input/output; evaluation/methodology; hypertext navigation and maps; video.

## General Terms

Documentation, Performance, Reliability, Theory.

## Keywords

Digital preservation, knowledge representation, classification, annotations, new media, art, theory.

## 1. Introduction to the Problem

There are as many different kinds of new media art as there are artists. New media art differs from traditional art in its non-physicality: instead of using paint and canvas to convey ideas, new media artists might use databases and CRT monitors; instead of modeling their subjects in clay, they might use computer programs to model data; and instead of being architects of physical spaces, they might build virtual spaces that house digital creatures, institutions, concepts or ideas. It also differs in its temporal quality. Unlike paintings,

sculpture or buildings, new media art is always changing and shifting – viewers can't be confident that they'll see the same thing twice. Preservation is typically considered a way to fix an object's physicality, to keep it safe from injury, destruction, and decay. When an object is neither physical nor fixable, however, this conventional view must itself change.

There are a number of cultural organizations that specifically collect and archive new media art, and there are numerous digital libraries that focus on the related form of interactive video, including performing arts libraries and news organizations. These organizations recognize preservation as one of their primary responsibilities as regards these artifacts, but affordable, viable and robust methods have not yet been developed. The main problem is that these are not "simple" digital objects, but are artistic in nature, and therefore signify something not easily communicable or translatable. Digital preservation methods normally focus on developing documentation for the systems and programs that run behind the scenes, technical metadata necessary for re-creating digital objects, and architectures to organize and store the objects most reliably. These methods do not capture the "essential nature" of a digital object; and in most cases, that would be inappropriate. However, in the case of new media and interactive art, where meaning is conveyed through software, system, data, and user interactions; preservation methods must document the essential characteristics of a piece, in order to provide meaningful access to these objects even in the near future.

Before delving into the specific problems of new media art preservation, it might be useful to illustrate the problem with an example. Imagine that you're the resident curator/archivist in a state-of-the-art digital repository. Your institution has developed a collection of interactive digital art, and one of the works for which you're responsible is 'Loops,' a digital portrait of Merce Cunningham by Paul Kaiser, Shelly Eshkar, and Marc Downie. Because of debilitating arthritis, Cunningham, one of the most influential dancers/choreographers of the twentieth century, is no longer able to dance but can still move his hands. For this work, Kaiser and Eshkar attached sensors to Cunningham's hands, and, using a combination of motion-capture software and 3D modeling techniques, recorded the sensor data from Cunningham's 'Solo Dance for Hands and Fingers.' Marc Downie then developed an artificial intelligence algorithm which would let the sensor-nodes individually "make their own decisions about how to appear graphically, how to move in relation to their underlying motion-capture data, and how to connect to each other" [9]. 'Loops' consists of a basic vocabulary of forms, movements, topologies, and interactions for each sensor node,

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or “creature,” eleven minutes of “script,” fifteen minutes of recorded narration by Cunningham, and ten minutes of music by Brian Eno, which are looped indefinitely.

One of ‘Loops’ main themes is interaction. Not only is the interaction internal: the sensor nodes are interacting with each other and with the underlying programming, but the artists wanted the presence of viewers in the gallery space to register within the visualization as well. Hence, the motion of the nodes in the visualization is slightly disturbed by the motion of people in the gallery space, and although these disturbances do not register on the main screen, but on synchronized secondary screens, they succeed in augmenting the viewers’ association to and interaction with the piece.



**Figure 1. Loops. Digital Portrait of Merce Cunningham. Paul Kaiser, Shelley Eshkar, Marc Downie. 2000-2004. From the artist’s website: <http://www.openendedgroup.com/artworks/loops/loops.htm>**

Because of the generative quality of these “autonomous creatures” (the AI enabled sensor-nodes), and their randomized reactions to each other and the world around them, Kaiser considers ‘Loops’ a live performance. Even though the piece returns to its beginning every ten minutes, it’s never the same piece twice. “Manifesting itself through the probabilistic interaction of its distinct parts, it has what is called an emergent structure, which means that it was grown as much as it was designed” [8].

Now, imagine how you would preserve such a system of interactions. Because this work changes with every performance, videotaping any given instance will at best be incomplete. If you decide to preserve the underlying code for later performance, there are a number of issues to take into consideration. First, there’s the data and programs that generate the work: the sensor-data created by Cunningham, the modeling program which generates the visualization, and the AI program that adds a transformative aspect to the data – all need to be kept intact. Second, you’ll need to make some decisions about presentation; can the work run on any kind of computer, or will you need a specific setup? What kind of sensors and recording devices do you need to record data from visitors in the gallery space? What kinds of projectors does the work use? What kind of screens? Are the screens and projectors important to the overall meaning of the work? How should the projectors be set up? Is the exact set-up important? Truly cutting edge technology is being used to generate this piece. What happens when this technology is no longer cutting edge? Should your institution consider updating the piece? Perhaps making the projected image a hologram? What if the artists themselves want to update the piece? How will you document changes? Finally, in addition to the technology and the presentation challenges, there are issues surrounding interactions and chance, which are built into the system, and play an integral role. There are many complex relationships in this piece, both internal and external, and authentic

representation will require a series of decisions about the quality of each. How will you make these decisions?

My thesis is an attempt to provide a framework with which to answer these questions. In addition to providing some discussion of the specific challenges facing the new media art and digital library communities, I will develop a set of guidelines that will help define those characteristics of a new media art object which are fundamentally valuable, and must be present for the object to retain its authenticity throughout its life. I will do this by exploring the similarities between the representation and preservation strategies of new media art and a more established variable art form, namely music, and trying to make connections between the two.

## 2. Digital Preservation Strategies

There are currently four digital preservation strategies commonly in use. The first three have technical origins, and should be familiar to the general digital preservation community. Related to “the viewing problem,” they are: *refreshing*, the upgrade of storage mechanisms; *migration*, the premeditated upgrade of file formats; and *emulation*, which focuses on development of operating systems able to run obsolete media. The fourth option, more radical, and developed by and for the new media art community, is *re-interpretation* [2]; a method intimately related to the presentation, exhibition, and performance of an interactive variable media art object.

### 2.1 Re-Interpretation: Permanence through Change

Technical approaches to digital preservation are not without problems. They subtly and invisibly alter those digital works they are seeking to preserve, and these alterations, particularly if they’re not recognized and referenced within some representation of the original object, are unacceptable from an artistic point of view. Re-interpretation allows preservation professionals to make decisions about the characteristics of an object’s presentation or performance within some pre-defined boundaries. Currently, artist questionnaires are the primary means of developing a representation of a variable media artwork with an eye towards re-interpretation [7], [14], [1]. Artist questionnaires are problematic for two reasons: first, and this should come as a surprise to no one; the artist questionnaire is complicated. Artists find it difficult to answer the written questionnaire, and when being orally questioned, their answers are almost always qualified, with “you’d have to ask me if that situation arose,” sorts of answers. The second notable challenge with artist questionnaires is the fact that artists were almost universally appalled at the technology available for preserving and reproducing their work. Many times throughout the ‘Preserving the Immaterial’ conference, the artists, particularly the older ones, whose art is ageing, would assert that the thing being displayed was merely a “record” of the art, not the art itself [4], [10]. If the art presented in an institution is only a “record of” the original work, what kind of record is it? Is it possible to know certain characteristics about the original thing from this record, or has that information been lost forever?

In mid-2004 Richard Rinehart, reflecting on the variability and related representational problems of this art form, delivered a paper arguing that new media art is more like a musical performance than it is like a painting or a book, and

therefore more appropriately represented by a scoring system than the text-centric methods used today [15]. His proposal of the Media Art Notation System (MANS), based on the MPEG-21 framework, is a welcome step forward in the development of a viable preservation schema for these highly variable and ephemeral objects. Rinehart's system, however, is more of a metadata framework or ontology than a scoring system, and therefore runs into the same general problems inherent in any text-based representational framework that attempts to describe or define a non-textual entity [17], and is based on the pervasive 'conduit-metaphor' model of communication [13]. Specifically, the success of a MANS representation depends on two things, both problematic: First, artists must understand and be able to meaningfully describe the important elements of their work; and artists' must be able to relate the importance of those often non-textual elements using...text. Are there any existing art forms that are both variable and do not depend on words for representation?

### 3. Existing Variable Art Forms

There are numerous examples of existing art forms that are variable and employ re-interpretation as the *de facto* means of delivery and representation: namely, drama, for which scripts represent the work; dance, which often makes use of a notational system to describe and record body movements across space and time (Labanotation being the primary example); and music, which is usually represented in the West using the Common Notation System (CNS). In order to develop a less text-centric representational model for new media art, I chose to explore the representation and interaction techniques of these art forms, which have interpretable or variable output.

#### 3.1 Music and Variable Media Art

Music, drama and dance each share characteristics with new media art. They're temporal: meaning they take place and change over time; they're performance based and ephemeral: the performance is the instantiation of the work, and once that performance is over, it's gone; and they're open to interpretation within some pre-determined set of values: although it is possible and expected to interpret freely, each form has a framework within which the director/choreographer/conductor must work. Music, however, has traits uniquely shared with new media art. These traits can be divided into two general groups: those having to do with interaction among elements within an work; and those having to do with the abstracted, or symbolic nature of the work's instantiation.

##### 3.1.1 Interaction

Music and new media art both share a dependence on specific and complicated interactions for reliable performance. This means that all instruments, in the case of an orchestra; and systems, libraries, data sources, and programs in the case of a new media art object, must interact in a specific way to produce a reliable version of the final product.

##### 3.1.2 Abstraction

Composers' and new media artists' creative impetus is marked by a high degree of abstraction. Not only do they communicate their artistic vision using highly abstracted and/or symbolic languages; they're using tools or specialized instruments to do it. Instead of using the immediately available bodies in motion of dance, or the spoken word of theater, composers and new media artists depend on the availability of tools to realize

their vision. Additionally, both music and new media art, because they do not rely on semantics and its attendant rules and forms to represent their work, have an incredibly rich denotative language. A forty-minute work by Schubert, for example, can be published in a five-page booklet. A complex Flash animation that pulls information from dynamically generated databases can be written using one hundred lines of code.

In the hopes of developing a set of characteristics to include in a new media art notation system, I have started exploring the information contained in musical scores. In addition to recording the fixed musical elements like pitch, rhythm, tempo, dynamics, and articulation; my research also seeks to understand musicians' interpretative decisions, as well as their interactions with each other and with the score. Interpretation and interaction are particularly applicable for the purpose of this research, because these are the primary means by which musicians achieve artistic, reliable performances, and that is the ultimate goal of any new media representation framework. Although it might be difficult to completely understand musicians' interpretative choices and interactions, I believe that the personal notes (annotations) musicians' make on the scores themselves can provide valuable information regarding these transient and personal decisions [12].

### 4. Research Questions & Project Plan

This project has two distinct phases, which will provide data to answer one question: Are there any elements in a musical representation framework that are particularly germane to the representation of a variable media artwork?

The first phase of this project focuses primarily on musicians. I am collecting scores from, and interviewing different types of musicians, who perform different types of music. I will then analyze that data, annotating their marked-up scores at the bar level. Research questions from this phase include: In practice, how do musicians decide which musical elements must be strictly adhered to, which can be improvised, and which must be freely interpreted? How is interpretation agreed upon? How do composers communicate over time, space, and cultures, their intent and goals regarding performance? Are there different models of interpretation based on different musical styles or genres? Do musicians at different skill levels annotate differently? Is there some way to operationalize these interpretative decisions?

After analysis of data from the first phase, I will develop a framework of variable elements, which might be useful for a new media art representation system.

The second phase of this project will focus on testing the framework developed in the first phase against "typical" variable media artworks. In this phase, I will choose a number of artworks and analyze the underlying architecture, code, and pseudo-code used to make each object run, using the framework from phase one as a guide. There are general research questions for this phase, including: Is the framework developed for music valid for new media art? Do any of the musical elements defined by the framework transfer successfully to new media art? Is there a significant overlap of elements or representational artifacts? The prevailing research question in this phase of the project is essentially the research question itself: Are there any elements in a musical representation framework that are particularly germane to the representation of a variable media artwork? Data collection on the second phase will begin in the fall of 2005.

## 4.1 Data Collection: Phase One

In order to ensure comprehensive data collection, I developed a collection framework consisting of two levels: musician mode and skill. The first level, the musician mode, has three parallel sublevels: composer, conductor, and musician; each equally important, and based on what I call a "hierarchy of interest." A *composer* might annotate another composer's score in order to get a deeper understanding of it, for the use of similar tropes and metaphors in their own work. A composer annotating his or her own work for the purpose of error correction or thematic editing is not the focus of this study, and will not be considered. A *conductor* is primarily interested in interpreting a score for expressive purposes, and is charged with the responsibility of organizing and leading the orchestra to produce authentic performances. Conductors mark up their own score, and often annotate musicians' parts for individual instruments or performers in the orchestra. Finally, *musicians* are primarily interested in interpreting their part for performative purposes. Musicians almost universally annotate their parts, generally marking up sections that are difficult or interpretable in some way.

The second level of the methodological framework focuses on the skill level of the users. I identified three levels for this study: amateur, college-level, and professional.

Two notes on the data collection framework: First, because this study is focusing on the representational qualities of the Common Notation System, I needed data from users for whom reading music is a non-issue. Rock and jazz musicians often do not read music, so their annotation behaviors and methods are significantly different from orchestral musicians. This requirement limited this study's user base to orchestral musicians, but interesting future work could be done on non-music-reading musicians. The second note concerns the presence of a leader in the musician groups from which I drew my data. Because my thesis is concerned with distinguishing those elements within a musical score which musicians find "important" enough to annotate, I want to identify those musicians who work with a conductor and therefore make fewer interpretative decisions (symphony orchestras, for example), versus those musicians who do not have a conductor, and make more interpretative decisions (quartets, for example).

At the time of data collection I also conduct interviews with participating musicians, asking questions regarding the processes and context of their specific annotation behaviors [11]. The purpose of the interview is to get a deeper understanding of musicians' attitudes toward interpretations and whether their annotation behavior is in fact an important element in understanding that interactive quality of musical performance.

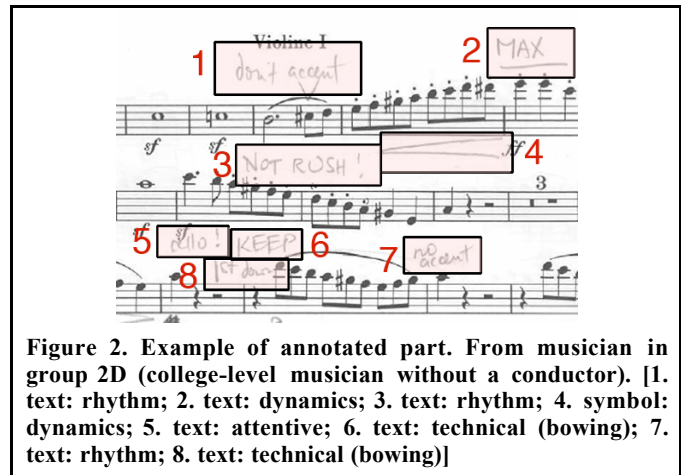
**Table 1. User Groups Directing Data Collection**

1A. Professional Composer	2A. College-Level Composer	3A. Amateur Composer
1B. Professional Conductor	2B. College-Level Conductor	3B. Amateur Conductor
1C. Professional Musician (With Conductor)	2C. College-Level Musician (With Conductor)	3C. Amateur Musician (With Conductor)
1D. Professional Musician (NO Conductor)	2D. College-Level Musician (NO Conductor)	3D. Amateur Musician (NO Conductor)

As of March 2005, I have collected data and interviewed musicians from groups: 1B, 1C, 1D, 2C, 2D and 3C. Data collection is ongoing.

## 4.2 Data Analysis: Phase One

After data collection, I will mark up and analyze any annotations the musicians, composers, or conductors might have made on their published music. There are two types of mark-up: structural, and content-based. At the structural level, there is the demarcation of bars and phrases. At the content level, there are three types of written notes: *textual*, where the musician has actually written a word in the margins; *symbolic*, where the musician has written non-textual symbols; and *numeric*, where the musician has placed numbers above or below notes for fingering or timing instructions. Content-level annotation is the most common type found so far. For both textual and symbolic annotations, the purpose falls into six categories: rhythm, emotive / mood, technical, dynamics, articulation, and attentive, which are based on information observed in perusing pilot study scores, and based on Downie's categories of music information retrieval [3].



**Figure 2. Example of annotated part. From musician in group 2D (college-level musician without a conductor). [1. text: rhythm; 2. text: dynamics; 3. text: rhythm; 4. symbol: dynamics; 5. text: attentive; 6. text: technical (bowing); 7. text: rhythm; 8. text: technical (bowing)]**

The final step in this process is to analyze the annotated scores, looking for n-way consensus, investigating any "important" or consistently documented elements. I will normalize at the basic unit of annotation, in this case at the bar level. I'll record all instances of annotation: who, where, what kind; and count all instances of annotation to provide percentages at the bar and phrase level between and among musicians and musical types. Finally, I'll conduct consensus analysis to determine how often annotations concur on selections.

## 5. Discussion

Although still collecting data for phase one, I believe I can provide some informal observations related to the knowledge, context and purpose of musicians' annotative behavior. This discussion will utilize data from the already collected scores, as well as the completed musician interviews.

### 5.1 Annotation as Thing

Annotation is a nearly universal practice among musicians. Every collected score contains markings, split between numeric, symbolic, and textual notes. Professional musicians

tend to have fewer notes on their music, and these tend to be symbolic rather than textual in nature. Musicians without a conductor – in this case, string quartets; seem to make more “textual:emotive” notes than orchestral members do. My hypothesis is that musicians in a quartet are more autonomous, and are charged with defining and presenting emotional cues to a much greater degree than orchestral musicians, for whom the conductor is the primary emotive factor. Conductors’ notes vary according to conducting experience and skill level, as well as prior experience with the music or composer.

Traditional classical music (such as Schubert, Brahms, etc.), as opposed to contemporary classical music, tends to get more “attention” from college-level musicians in terms of annotations; I am unsure whether this is a product of the stark nature of the piece itself; the piece for which I have collected data, for example, is “Rainbow Body” by Christopher Theofanidis, and has 150 bars of “rests” for the bass section. One of my interviewees mentioned that there’s not much to mark when “you’re sitting there counting for seven minutes.” The professional quartet, playing a piece by Shostakowitch, however, found quite a bit to annotate. Is this difference due to the higher skill level and hence buy-in from the professionals, or is it a quality of the music? More formal analysis will hopefully provide answers.

## 5.2 Annotation Context

When I asked musicians about the reasons for an process of annotating their musical scores, I found that, not surprisingly, they use annotations primarily as a reminder function; their primary goal is to not make any mistakes during performance, and they annotate their music at sections they know are difficult, where they’ve already made mistakes, or where they think they might make a mistake in the future. Abrupt time changes, playing after long rests, or unexpected solos (“if I don’t mark that it’s a solo, I might wonder if I’m playing by mistake when I hear it’s only me...”) are particularly problematic. In this case annotations are primarily used for performance purposes, rather than practice or for learning the part; although by performance time, the notes that annotations symbolize should be internalized to the degree that the musicians no longer need them. When asked if they could perform well without the annotations, the majority responded that by the time they were performing in front of people, they didn’t need the annotations any more. However, if they had to come back to this piece after years away, their annotations would be very useful as a starting point to learning the piece again.

## 5.3 Annotations as Evidence of Interpretation

In answer to the question “which musical elements in a published score are commonly understood to be freely interpretable,” a professional level cellist said that essentially every element in a musical score is “up for grabs,” including pitch. He believes that the published score is more of a guide or recommendation than a command. Whether or not this attitude is true for most musicians is itself up for grabs, but my exploration of the data shows that there are musical elements most musicians are comfortable changing, and there are elements typically left unchanged either because of tradition, or because change is technically difficult.

My observations of rehearsal processes indicate that when musicians do make interpretative decisions, they almost

always make a note of it on their music. In fact, informally speaking, I’d speculate that the majority of annotations are evidence of interpretative decisions.

## 6. Conclusions & Future Work

The lion’s share of data collection for the first phase will be completed by June 2005. That summer will be spent developing a framework of interpretable or changeable elements within a new media work, and next fall I will begin collecting data from new media artists, curators and archivists. The winter holidays will bring data analysis and writing. I hope to finish and defend my thesis by December of 2006.

In addition to my research agenda of developing a framework for a new media scoring system, this research has numerous applications for the music digital library community. Although there are no previous studies on the annotation behaviors of musicians, most music digital libraries have an annotation facility. For example, Variations2 at Indiana University has a well-developed annotation facility for scholarly use [6]; and HotBed at the Royal Scottish Academy of Music and Drama allows traditional music teachers to annotate problematic or difficult sections of pieces they’re teaching [16]. My research will offer these systems’ developers valuable data on musician behavior and need in the analog setting, and will hopefully provide enough information for the development of robust, more powerful annotation tools in the digital environment.

In the more distant future, analog orchestral annotation is problematic, to say the least. Although there’s been development of a digital music stand for symphony musicians, that product didn’t succeed due to monetary and cultural problems [5]. If cultural organizations can ever overcome these issues, my research will prove beneficial to the development of a new digital music stand.

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