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Screen Scores: New Media Music Manuscripts

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ABSTRACT

This paper examines the screening of music notations and the impact of this configuration in a live music performance situation. Before the development of graphical computing, Traditional music notation, was rarely shared with the anyone other than other musicians, composers and analysts; let alone displayed during the performance. However, some composers experiment with scores and their visual presence in performance by employing automated 'score-players' or actual films specifically developed to be interpreted by musicians. This paper raises some questions and possibilities for this new way of sharing musical qualities of composition and performance.

1. INTRODUCTION

In relatively recent times, a range of new paradigms for the presentation of notation to live performers has emerged as a result of the possibilities afforded by presentation of scores on screen. This approach provides an opportunity to display or project scores in the traditional form (segmented into staves), but importantly can also coordinate the score in alternate modes, for example as a continuous scroll or allowing for more "mobile" paradigms in which the score is permutated, transformed or generated in real-time.

The actual mobility of the musical score has been a product of developments in technology. The rapid improvements in graphics processing capacity, smaller, lighter and cheaper screens, data projection have all played an important part in promoting the exploration of these possibilities. Development of a range of software capable of robust real-time manipulation of notation began to emerge in 2007[1] and has also enhanced potential of this approach.

Although there were a number of precursors to the presentation of musical notation on screen, academic discussion this approach is also quite recent, gaining momentum as recently as 2004 with the publication of research by Didkovsky [11] and Winkler [34][2].

We are proposing that the range of approaches to the digital presentation of notation have resulted in a technology that is best referred to as the "screen-score". This paper proposes to classify the range of practices that have emerged in this rapidly developing field.

2. THE EMERGENCE OF THE SCREEN-SCORE

In the Platonic conception, art works are seen as a duality comprising the "real" Idea and the "symbolic" Representation [15]. Although some art forms, such as Motion Pictures, Visual Arts and perhaps Dance, arguably bring the idea and its representation closer to some form of unity, Art Music has traditionally maintained a strict separation between the scored representation and the embodied performance. Since the development of European music notation as we have known it (in the tenth century by the Italian monk Guido d'Arezzo), the process of composition parted from that of performance and the notion of a musical 'work' and an abstracted standalone entity emerged. The notated score became a code for the trained musician to translate into performed, 'temporal' music.

In the Visual Arts, numerous projects sought to explore the visualisation of music. Interestingly there was little cross-over between the "Visualised Music" and the "Sonified Image" of the musical score.

Despite the progress of musically generated visual abstractions prior to the advent of graphical computing, it seems these projects had little influence on the course of musical composition. The experiments of Kandinsky, Schoenberg and Scriabin[3] did not engender a new medium for musical presentation.

Later developments, mostly from the visual arts, included Arseny Avraamov's hand-drawn motion picture soundtracks (1930) [22], Len Lye's *A Colour Box* (1935), cameraless animation, abstract films painted and scratched directly onto film [28] and James and John Whitney's experiments (1943-4) in which sounds

[1] In addition to individual solutions based in notation-capable software such as JAVA and Max/MSP, generic real-time notation software has been developed by Barrett, Winter and Wulfson: *LiveScore* (2007), Psenicka*: FOMUS (2007),* Didkovsky and Hajdu: *MaxScore (2008),* and Lopes: *Õdaiko* (2010).

[2] Other notable contributions have been made to the debate by Kim-Boyle [23][24][25], Barrett, Winter and Wulfson [2], Freeman [16][17], McClelland and Alcorn [29], and Lopes [26] Contemporary Music Review Issue 29 (2010) (Clay and Freeman eds.) was also devoted to the discussion of "Real-time Scores".

[3] Kandinsky's total theatre work *Der gelbe Klang* (1909) synaesthetically combined dance, music and coloured light [39] Scriabin's *Prometheus* (1910) used a colour organ to project coloured lights during the performance and included notated score for the lights [30]. Schoenberg's *Die gluckliche Hand* (1913) included specific indications of colors to be projected onto an on-stage screen and made very detailed colour sketches for this production [27].

and images were synchronised optically by light shot through a stencil system [3].

It is strange to note that in the Avant Garde scene of the 1950s and 60s, the work of numerous abstract filmmakers such as the Whitneys, Fischinger, Harry Smith, Joseph Cornell, Maya Deren, Kenneth Anger, Stan Brakhage and Jordan Belson, did not exert more influence on the experimental music works of the New York School and the Fluxus movement.

As revolutionary as composers in the New York school were musically, the presentation of music to musicians remained relatively unchallenged. Both Morton Feldman and Earle Brown have indicated indebtedness to their contemporaries in the visual arts such as Jackson Pollock, Alexander Calder and Mark Rothko (see Feldman 1988 and Brown 1986). Feldman created numerous works that are notated using graph paper, such as the *Projections* (1950-3) and *Durations* (1960-1) series [21]. The graph works are uniformly performed from the full score, making them eminently suited to projection, however the performance practice of these works has remained faithful to the "paper and music stand" medium of traditional notation. Similarly, Browns "open works" [4] from *Twenty Five Pages* (1953) onwards, with their interchangeable sections and variable page orientations, are tailor-made for projection.

Before the advent of graphical computing, composers had begun to explore the idea of the score as an autonomous art-work. Scores by Roman Haubenstock-Ramati, Sylvano Bussotti, George Crumb and others began to diverge from the horizontal systems of traditional notation and explore the notion of a closer correlation between the Idea and its representation. This development, and its conceptual implications, arguably made these scores of greater interest to the audience.

> During the compositional process a reciprocal relationship develops between the idea (thought) and the slowly evolving manner of writing it down. This relationship of continuous mutual influence lasts during the whole time of composition, and has the effect that, if the original idea of the work is musically pure and true, the resulting piece will be the best possible in terms of both music and notation [20].

Composers also extended the conventions of notation in search of a way to share new compositional concerns such as extended techniques, or aleatoric choices. In some case this involved abandoning notational conventions completely in favour of novel means of representation: so-called graphical notation. As Cornelius Cardew put it:

> Notation and composition determine each other. Differentiate between creating a language in order to say something and evolving a language in which you can say anything [9].

Earle Brown's *December 1952* is thought to be the earliest example of this approach. The work is an example of asemic graphical notation – it does not privilege any manner of reading or interpretation. To most trained music readers it presents more like a painting of the Neo-Plasticism school than a musical score. This observation is not irrelevant. Brown himself stated:

> I was once very envious of painters who can deal directly with the existent reality of their own work without this indirect and imprecise "translation" stage [4].

Cage and others also amplified the existing ambiguities of musical notation to create scores in which the semantic interpretation is indeterminate.

> One cannot determine exactly what effect the notation causes. The observer-listener is able to stop saying I do not understand, since no point-to-point linear communication has been attempted [7].

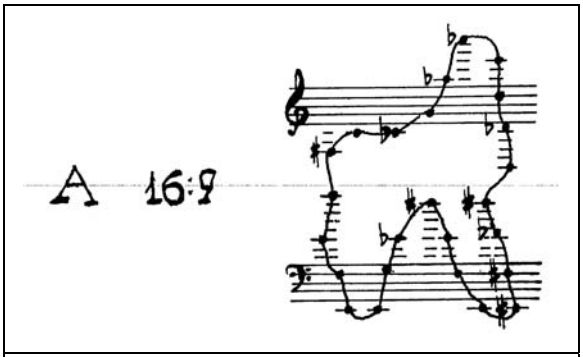

Figure 1: A fragment from John Cage: *Concert for Piano (1958)*

Figure 1. shows an example of ambiguous, but graphically striking notation from one of the sixty three pages of Cage's graphical notation magnum opus *Concert for Piano* (1958). The accompanying instructions state:

> Following the perimeter, from any note on it, play in opposite directions in the proportions given. Here as elsewhere, the absence of indications of any kind means freedom for the performer in that regard [5].

Such notation presumes that "the performer's mind is (…) inspired by the graphics through some sort of mental resonance"[18].

A simultaneous development in notation was that of the mobile score, the idea that a music notation (graphic or otherwise) could be reordered or reorganised for, or even during, each performance. Mobile Scores most commonly offered performer choice in the pathway(s) taken through the work. The ability for performers to read rhythm from right to left, or for composers to express harmony from top to bottom, was no longer required.

> This notational "problem" in 1952 not only led to my finding a notation which was much more suitable for my musical language in a technical sense, but also discovering the "graphic" potential for dealing with the problems of "mobility" and immediacy which

had been of great interest to me since the influence of Calder and Pollock in approximately 1948 [4].

Graphically notated works raise the score from a prosaic, codified and universal medium for transmitting musical information to the level of an individual, idiosyncratic artwork. This is illustrated by the fact that graphical scores are publically exhibited as art works in their own right[4], and books featuring such works have been published [6] [32] [35]. Yet strangely, the scores are seldom presented to the audience in the context of their actual performance.

Argentine composer Mauricio Kagel's work *Prima Vista* (1962-63) is a clear example of a graphical score composed with the intent to be projected. This piece uses 25 slides randomly placed in the carousel of a slide projector, and is one of the earliest examples of score to be screened visible to both the musicians and audience. The projector enabled the performers to organise the slides randomly, and as the performers are grouped into teams, enabling the audience to engage with the game like nature of the work.

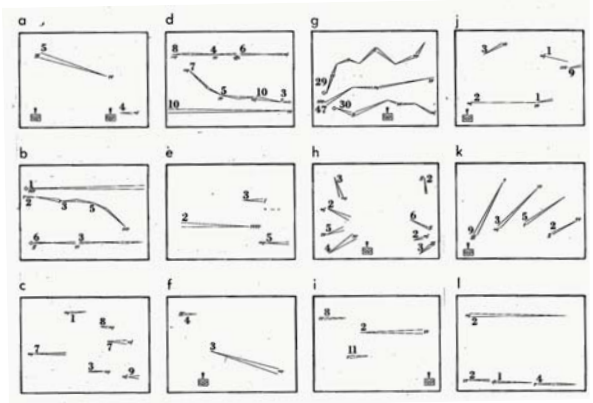

Figure 5: Score components (Slides a. through l.) of Mauricio Kagel: *Prima Vista (1962-3)* (Excerpt)

Experiments with traditional paper scores, such as multi-pathway "mobile scores", might be said to be the remnants of old artistic media *"pushing against their own boundaries*" [36]. Yet there has been little experimentation with presenting scores to the concert going audience, or challenging the notion of the score as a static entity.

3. CLASSIFYING THE SCREEN SCORE

Clay and Freeman note that terms to describe the range of new approaches to presenting the score have not yet been standardized [10]. There are four principal considerations governing the relationship between these new screen-based approaches and the traditional notated score.

[4] For example: "Pictures of Music" at The Block Museum Northwestern University, Illinois. (http://www.blockmuseum.northwestern.edu/picturesofmusic/index2.html), Notations 21 at The Hutchins Gallery. http://notations21.wordpress.com /notations-21-exhibit-visuals/

1. *Medium* - the expanded range of approaches may give rise to either static or dynamic arrangement of materials analogous to traditional print text and computer-based hypertext.

MEDIUM	COMPOSITION	PERFORMER	SCORE
Screen-score	Generative	Immanent/ Interactive	real-time score
	Transformative		
	Permutative		
	Sequential	Interpretative	scrolling score
Paper-score	Permutative	Explorative	Mobile score
	Sequential	Interpretative	traditional score

Table 1. Paradigms for the presentation of notation to live performers[5]

2. *Composition* - the musical materials may be configured so that they are read sequentially, permutated, transformed or generated in real-time. The computer-generated score provides a seamless medium for such approaches.

3. *Performer* - the relationship between the performer and the score may be characterized as interpretative (of a traditional score), explorative (of a "mobile score"), 'Immanent' in that reading may be expected to occur more "in the moment" or interactive in the case that the performer's actions result in changes in the score.

4. *Score* - Traditional musical notation implies the abstraction of taking a continuous 'scroll' of music and splitting it into sections that can be arranged on successive pages. The scrolling score uses the computer to actualize the continuous paradigm of linear music on screen. In the mobile paper score, the notation remains fixed on paper, but "the order of musical sections is outlined either just before or during performance" [25]. The real-time score "refers to any notation, either traditional or graphic, which is created or transformed during an actual musical performance" [10].

3.1. The Scrolling Score

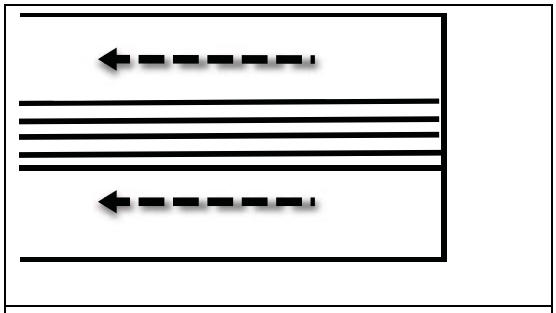

Figure 3. Scrolling Score and fixed playhead

The scrolling score moves a continuous notational graphic from left to right, allowing performers to execute events as they strike a fixed 'playhead'. This approach is best suited to scores that are notated proportionally, that is the time durations of the musical

[5] The categorizations in this table are based on similar categories proposed by Aarseth in his work on "cybertext" [1].

events are proportional to the spatial lengths of their graphical representations.

In traditional notation, note lengths are principally determined by their shape. To save space, traditional scores do not typically place musical events proportionally on the page: longer notes tend to take less space in comparison to short notes and spacing may be dependant upon the duration of events that are taking place across multiple staves.

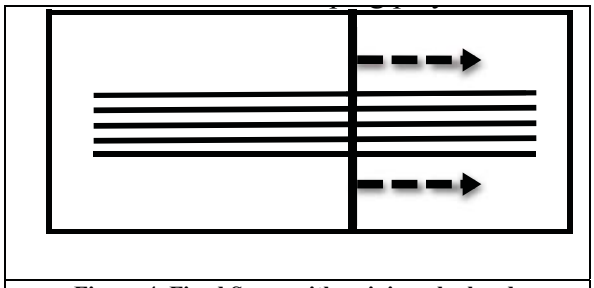

Figure 4. Fixed Score with swiping playhead.

For this reason the scrolling score is best suited to proportional graphical notation. It allows graphical scores that would normally need to be broken up over multiple pages, such as Penderecki's *Threnody to the Victims of Hiroshima* (1960), to be presented to performers as an unbroken continuum, revealing to the performer what they realise in each moment as well as what will be subsequently realised.

It is also possible to swipe the playhead across the score. Such an arrangement limits the amount of graphical material that is visible to a single page or "screen". It is therefore not suited to the presentation of continuous "multiple page" scores, however this limitation provides the opportunity for nonlinear presentation of the material, in the manner of a permutative score.

3.2. The Permutative Score

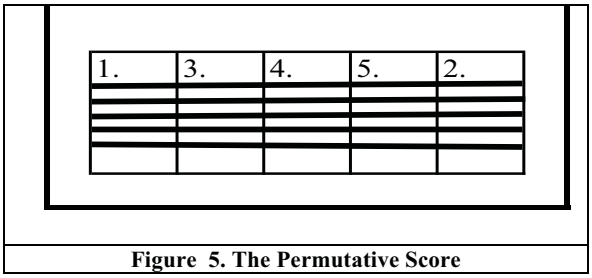

Figure 5. The Permutative Score

The permutative score allows the presentation of materials to the performer in an indeterminate order. It is capable of being continually "refreshed" with additional materials of any duration. This approach is suitable for traditional or graphical notation. The ordering of the events may be determined algorithmically, by the computer or interactively through an interface, such as hardware or computer listening. In Jason Freeman's *Glimmer* (2004) for chamber orchestra and audience participation, for example, the audience influences the unfolding composition "by waving four-inch battery-operated LED light sticks back and forth" in front of video cameras' [16].

3.3. The Transformative Score

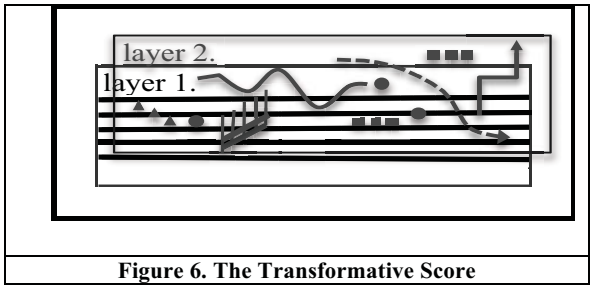

Figure 6. The Transformative Score

The transformative score allows a fixed score to be altered in real-time. It is the digital descendant of Stockhausen's *Refrain* (1959), a work in which the score is overlaid by a mobile clear plastic strip that modifies whatever the material is below it and John Cage's *Cartridge Music* (1960), which invites performers to assemble "a combination of sheets and transparencies to create each part" [31]. In addition, the computer provides a medium in which the score itself can be graphically modified on the screen in a mobile manner.

3.4. The Generative Score

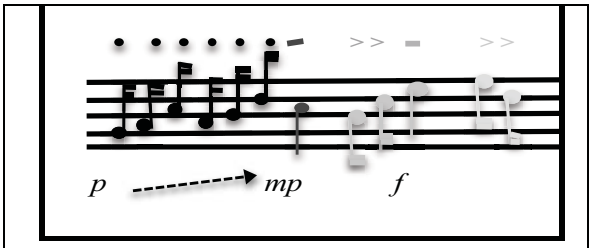

Figure 7. The Generative Score -Traditional Notation

The generative score constructs components of the score in real-time. The components may comprise traditional or graphical notation or a combination of both. Algorithmic or interactive methods of generation may be employed, with the score moving from left to right or cyclically like a closed loop of paper. In David Kim-Boyle's *Music for 2* (2003), for example, "the pitch grid displayed for the performers, is dependent upon the dynamic level with which preceding grids are performed" [25].

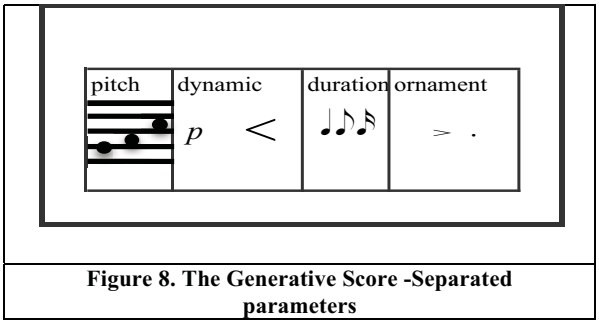

Figure 8. The Generative Score -Separated parameters

Additionally, elements of the score may be presented to the performer independently. This approach is used in the extended notation of the highly complex paper scores of Aaron Cassidy[6], that often notate different components of instrumental technique on up to ten independent, simultaneous staves. Application of these ideas using digital media allows for these processes to take place in real-time.

This approach is exploited in Gerhard Winkler's *Hybrid* series (1991-), which permit

> unique navigational pathways through the work to be explored, and opens exciting formal and notational possibilities which clearly cannot be achieved with paper-based notational systems [34].

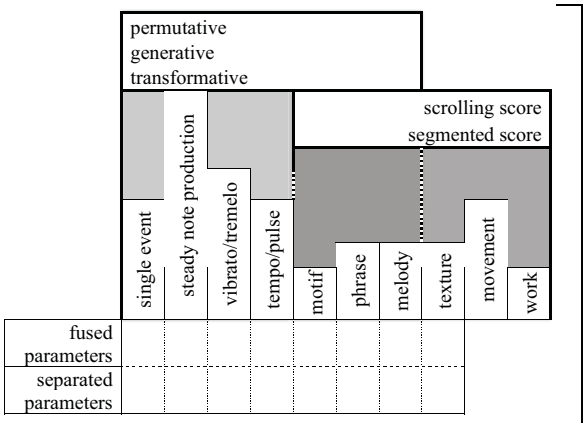

Table 2. Classification of Score components that can be presented in a Screen-Score

In general terms, scrolling and segmented presentation of a screen score is best suited to a pre-composed score that is both continuous and linear, while permutative, transformation and generative approaches suit nonlinear real-time instantiation of scores that are nonlinear in their conception.

Figure 9: "vertical" generation of materials resulting in "blocks" (above) and horizontal generation of materials resulting in "layers".

The screened score also provides the opportunity to coordinate the presentation of materials in a "vertical" or "horizontal" manner. Vertical coordination generates changes across all parts simultaneously resulting in "blocks" of material while horizontal coordination, generates material in "layers" given that the materials are sufficiently distinct.

4. SHARING THE SCORE

> One general effect of the digital revolution is that avant-garde aesthetic strategies became embedded in the commands and interface metaphors of computer software. In short, the avant-garde became materialized in a computer [28].

The advent of cheap, portable and powerful computing has clearly been a "game-changer" in the development of the screened score. Not only does it afford relatively simple configurations of equipment to facilitate projection of the score, it provides a medium that permits novel approaches to the manipulation of materials, namely real-time algorithmic permutation, transformation and generation.

Sharing previously hidden aspects of the performance via video projection is becoming increasingly common in the presentation of New Music. Kate Maloney suggests that the increasing use of projection in musical performances is:

> Potentially a response to the mystification caused by the increasing use of complex technology in sound performance, many contemporary artists seem interested in finding ways to minimize the inevitable concealment of their artistic process that results from performing with high-tech equipment such as laptops and digital processing units [27].

The process of sharing the score might also be seen as more generally demystifying classical music's code of performance practice, which customarily involves the privileged relationship between the performer(s) and the notated score, which is usually concealed, (along with the performer(s)), from audience by opaque music stands.

Although perhaps admirably revelatory, the projection of the internal workings of the performance do not necessarily address the problems of audience comprehension or even curiosity. In the case that the notation system itself remains obscure to the audience, video project may simply add a further, potentially distracting, layer of opacity. Maloney notes that projections of the object-oriented programming language MAX/MSP often leave the audience confused and unsatisfied.

> For the inexperienced MAX/MSP viewer, the projection merely offered a complicated graphic interface. The intricate patterns of lines, text boxes, and sliders cannot fulfill the desire for information they create [27].

When graphic scores are employed, there is perhaps less specialist decoding required than for complex languages such as traditional musical notation and programming code. In many cases, non-standard graphical notation is nearly as unfamiliar to the performer as is to the

[6] See Cassidy's notes to his solo saxophone work *asphyxia*: http://www.aaroncassidy.com/music/asphyxia.htm

audience and the 'codes' employed in realising the symbols are a source of interest and speculation the audience. Hence, an untrained (non-musician) audience member is likely to understand at least certain elements of the scores. This understanding means that the audience member will engage with the score in a way they would not using more traditional music notation.

But the effect of this engagement is not fully understood: does this sharing of the 'performance space' with a video projection enhance, or reduce the effect of the music being performed? Those who focus entirely on sound in a musical performance may argue visual representations are irrelevant and worse, distracting. Others may argue it has a pedagogical function, educating the audience in the art of interpreting graphic scores.

Another possibility is that a new kind of artwork is presented. Like a sound installation where the site of the sound is important, the screening of the mobile scores could be seen as creating a new kind of performance, just as the presence of music in cinema has enhanced that experience.

5. THE SCREEN-SCORE IN PRACTICE

In a traditional acoustic performance model (Figure10), coordination of the performance is, in the first case, determined by the composer. The composer provides materials that incorporate both events to be performed and a tempo/metric framework for their synchronization. Coordination of the actual performance is managed by the performers alone, through visual cues and auditory feedback.

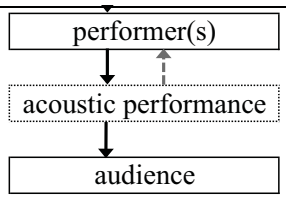

Figure 10. The traditional "Classical" acoustic performance model.

Computer coordination of live musical performance (Figure 11) allows for the control and synchronisation of the score and the temporal framework, in addition to the generation of electronic sounds and electronic transformation of both the acoustically and electronically generated sounds.

The computer-generated clicktrack creates the opportunity not only to independently control the tempi of multiple performers, but also to transmit formal (for example nonlinear selection of score materials) and performance (such as articulation, dynamics and so forth) parameters in real-time.

Computer coordination can control many components in a performance in a manner analogous to the team of players necessary to bring symphony to life. Auditory and visual cues still play an important role in the coordination of the live performance, importantly however, in a computer controlled performance feedback into the system can also be achieved though other means:

- the performers may interact with the computer via hardware interface(s);
- the acoustic performance itself may be used as an interface through computer analysis; and
- the audience may interact with the computer, playing a role in defining the performance.

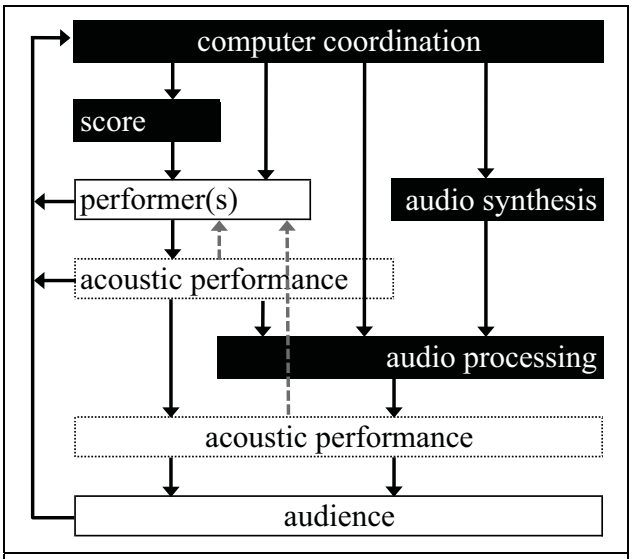

Figure 11. A computer controlled performance model

For centuries the relationship between the composer, the score and the performer has remained remarkably constant. The advent of random access computing has created a range of new opportunities for revolutionising the interaction between the parties involved in musical performance.

> The essential quality of scores is that it is a system of symbols which can convey, guide, or control the interactions between elements such as space, time, rhythm, people and their activities and the combinations which result from them [19].

The screen-score is a valuable tool for conveying the essential qualities of notated music. Making images of the score accessible to the audience does, however, bring with it certain problems that detract from the screen-score's value. Screen presentation of the score is necessary or at least enhanced if it:

- allows an already existing work to operate more "naturally" than the media available at the time of composition.
- conforms to the composer's conceptualization the work as comprising visual and auditory components.
- adheres to or more closely corresponds with the composer's intentions in regard to permits conceptual or structural goals to be realized.
- assists the comprehension of the work by the audience.

- does not unduly add to the cognitive load of attending the work.
- does not detract from the dramatic performative aspects of the work

The screen-score may be considered a novel direction in New Music or perhaps a continuation of the medium Visual Music pioneered by the Whitneys, Fischinger and their colleagues. Its consolidation in the performance practice of the future provides both opportunities, and also the potential for some unexplored and potentially negative consequences.

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