Conceptual Integrity in a Music Notation Program.

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Abstract

Notation is an experimental music notation program based on a consistent visual metaphor: two-dimensional musical scores are seen as three-dimensional constructs made of piles of individual notational elements called glyphs. Equivalent to tree structures, these piles specify hierarchical relationships defining temporal ordering among their component glyphs. This unique representation scheme both suggests and demands an equally unique style of user interaction.

By basing all operations on the three-dimensional metaphor, a user interface achieving a large measure of conceptual integrity is possible. This paper describes the implementation of that metaphor as embodied in the program.

Background

Many compositional activities are carried out without the aid of any visual symbolic system. Music is the art of sound in time, and improvisational styles and folk traditions flourish without any form of written notation. Yet for many musicians, some visual symbolic system, whether conventional or not, is an essential element of their compositional process. For centuries, the tool of excellence for symbolic musical thinking has been the pencil and paper. The system presented here uses the power of contemporary technology to offer an alternative.

Notation is the name of an experimental program for computer-assisted composition featuring a music notation system embedded in a visual programming environment. To the system, the images and conventions of particular notational styles take the form of data encapsulated as object specifications in an object-oriented programming language. Notation’s objects all display a specifiable graphics image; they are characterized as much by this image as they are by their state and behavior.

In Notation, visual elements of musical scores are represented as special objects called glyphs. Visually, these glyphs offer a two-dimensional rectangular surface displaying a specifiable image. Conceptually, glyphs are cubes of unit thickness, and may be piled on top of or alongside of each other in a virtual three-dimensional space. The rectangular surface on which a glyph’s image is drawn is completely transparent; only the image itself is visible, thus complex images can be built up by creating piles of individual glyphs. Figure 1 shows a portion of a common music notation score alongside a representation in which its glyphs are made opaque and given thickness in order to emphasize their three-dimensional structure.

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3 More precisely, two-and-a-half-dimensional, or two continuous dimensions and one discrete one.
The User Interface

I will contend that conceptual integrity is the most important consideration in system design. It is better to have a system omit certain anomalous features and improvements, but to reflect one set of design ideas, than to have one that contains many good but independent and uncoordinated ideas. [Bro75, pg. 42]

The three-dimensional, transparent glyph metaphor strongly suggests a unique style of use interaction. By basing all operations strictly on this metaphor, Nutation's user interface achieves a large measure of conceptual integrity. Instead of obliging musicians to rummage through voluminous technical documentation, the interface allows them to predict how certain actions are achieved by inference from the metaphor.

Rather than the well-known cut-and-paste editing style, the metaphor suggests a 'clone-and-move' strategy. Mouse selection allows any glyph to be moved anywhere else in the representation. Alternately, the clone (deep copy) of a glyph may be created and moved. The scope of these operations is determined by the 'size' of the unit selected: any operation which can be done on an individual glyph can be done on a pile of glyphs.

Any glyph pile may be 'frozen' together so that the pile behaves exactly as if it was a single glyph, then 'melted' to restore access to the individual component glyphs. Multiple glyphs from separate piles may also be manipulated: analogous to the shift-click, multiple selection process of cut-and-paste editors, multiple glyphs may be frozen to an automatically-generated 'tray' glyph. The entire unit may then be moved or closed as desired. Melting a tray results in the automatic edication of that tray.

Nutation is a multi-window system, and glyphs may be dragged from one window to another. Deletion is accomplished by dragging a glyph from its window, then releasing it over the desktop outside of all windows. The system has no need for any special 'paste' scheme for creating new glyphs. Instead, windows are pre-loaded with the glyphs needed for a given task, then clones are dragged from that window into the window containing the score. As a result, the system's conceptual load on

* [BP92B]: investigates strategies for dealing with scope in interactive score editing. Nutation's approach is similar to their category of "scope of Named Structural Entities."
the musician is kept to a minimum, for there is but one kind of window and one set of operations to master.

Nutation's visual system makes extensive use of clipping. When a larger glyph is placed over a smaller one, its image is clipped to the rectangular border of the smaller glyph. This provides a means of hiding detail: clipped regions of a glyph do not reveal themselves until they have been dragged off of their ancestor. Through this mechanism, it is possible to design notational worlds in which the entire structure of a composition, from its formal description to its samples, is graphically represented. To illustrate, Figure 2 shows a musical phrase which has been pilled onto a much smaller 'label' glyph, effectively suppressing the detail of the phrase. The view on the left shows the label glyph with the phrase sitting upon it. On the right is a 'raised' display with clipping turned off to show the hidden structure.

State of the Research

Nutation has been fully implemented on a NeXT machine, and currently supports a subset of common music notation and an Okinawan tablature system for voice and samisen. Using the NeXT's built-in synthesis hardware, Nutation produces high-quality, real-time performances of the scores it displays.

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References
