Designing an Instrument to Perform Abstract Animation in Real-Time

Presented at the San Francisco Performance Cinema Symposium, September 27, 2003

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The designer of a visual instrument that is oriented to improvisation must balance the demand for expressive utility with the need to produce an instrument with a playable interface. My design goal has been to create instruments that will allow about the same level of expressiveness as a piano, guitar, or trap set and that make similar learning and interface demands.

The problem was clearly articulated at least as early as 1930, by Adrian Klein who wrote:

> Within the prescribed limits of space, it is required that everything, colour, form, and direction of movement shall be subject to any conceivable modification….Somehow or other, we have got to treat light, form, and movement, as sound has already been treated [Klein 1930, p. 195].

Around the same time, Thomas Wilfred argued that the same basic dimensions—color form and motion—should serve as the basis of the new art he referred to as lumia. While most of the experimental work until that time had been largely related to color, Wilfred felt that form and motion were the more important two [Wilfred 1947, p. 252].

Imager uses Max, a MIDI control environment that runs on Macintoshes, to provide players with interfaces to control color, form, and motion. My own performance environment uses such interfaces as the ZenDrum, the Tactex controller and the Kurzweil ExpressionMate, along with foot pedals, to play with colors, shapes, and movements rhythmically.

My initial design goals included creating an instrument that would allow me to produce lumia that move like music, that approach the depth of musical compositions, and whose individual frame's would stand alone as images. In addition, Imager had to be controllable by a single player and permit improvisation in real time so that the player could respond to music while listening to it.

So, what is required in order for an instrument to be expressive? The cybernitician Gordon Pask posited that aesthetically potent environments share four characteristics. First, they provide sufficient variety to provide novelty. Next, they provide forms that can be interpreted at various level of abstraction. They provide cues to guide learning. And finally, they are responsive, engaging the player in discourse.

Getting sufficient variety is pretty easy. Each of the three factors identified by Wilfred is itself made up of many dimensions. Color, for example, is made up minimally of hue, saturation, and value. By combining a number of colors so defined, one quickly has thousands or millions of possibilities for color combinations at any moment. Indeed, the problem once one begins implementing a graphic model based around color, form, and motion, is not coming up with enough variety, but rather managing the rapidly expanding sources of variety. As Brian Eno observed about music synthesizer design, the temptation is to head "towards giving you more and more options. It's not more options that you want. It's more useful options [Imaginary Landscapes]."

Historically, we live in a propitious time for providing forms that can be interpreted at various levels of abstraction. The modern abstract artists have created an impressive body, both of artworks and of written works that address this very point. From Kandinsky's *Point and Line to Plane*, through Klee's *Notebooks* and Gyorgy Kepes' *Language of Vision*, they have provided quite detailed descriptions of the use of form at various levels to achieve a variety of expressive goals.

An issue that interested Kepes, for example, relates to achieving "rhythmical patterning of the picture surface." He proposed that rhythmic patterns can be achieved at several levels. On one level are the relationships of objects subdividing the picture plane. A higher level of rhythm is reached as the optical units are related to their virtual movement to and from the picture plane. "Finally we might have orderly changes or repetition of more complex configurations of visual experience; rhythmic order of tension and repose, concentration and rarefaction, harmony and discord". That these are similar to ideas explored by composers was not lost on Kepes:

> Music suggests an excellent analogy. A musical unit played by an instrument is repeated contrapuntally on other instruments, on the strings, on the brasses, on the woodwinds, even on percussion instruments. Each plastic unit with its specific sensory quality echoes the previous one; light, dark, color, shapes, forms, all mutually help one another, one taking over the movement where another stopped, leading toward complete unity [Kepes 1944, p. 54].

The problem of providing cues to guide learning is at the very center of modern instrument design. In a recent review of Pinch and Trocco's book on the history of the synthesizer, I wrote:

> For the attentive designer, there are lots of other lessons in this book. They found that one of the things that worked best about the control panel for the Minimoog was the way in which knobs were staggered. "It turned out that having things not all in military formation made it a lot easier for someone to find a control." Further, tactile controls like rocker switches permitted players to find their way around using feel [p.225]. And it is important in a musical instrument for the musician to be able to dynamically alter the sound in very small ways. "For many musicians, it is

> the pitch wheel on the Minimoog that enables them to make the instrument come alive. By bending a pitch or adding vibrato, a note can be given that special personal touch that violinists and guitarists find so important [p. 228].” These and similar lessons will, I think, have wide application in the design of instruments, even instruments that are used for purposes other than making music [Collopy, 2003].

Choosing the dimensions that the player controls, and determining such things as how presets are recalled and sequences are defined are problems the designer must solve both at an instrument (general strategies) and at an individual performance level (e.g., what exactly will the pedal control during this particular piece?). Fortunately, modern synthesizer design environments like Max make it possible to leave a lot of this to the performer. In the design of Imager, I have provided a general constructivist model of form and movement, along with a painterly color model [Collopy 2000]. These are presented in an environment that allows the user to configure and interact with them using whatever controllers she wishes.

Pask’s last issue, engaging the user in discourse, is the most complex. What makes an instrument engaging is an empirical question. Given my experience to date, the instrument must be physical. I like the Zendrum because it is possible to locate controllers in the dark, remember their particular meaning by physical association and move easily while playing it. It responds to speed and force equally well, and it is easy to map rhythmic events in much the way that a drummer uses a kit to do that same task (indeed it was designed for drummers). I like the ExpressionMate because it permits me to bend or adjust a color or movement after the initial attack. This attack and adjust strategy is commonly employed by musicians and allows one to benefit from feedback.

No single instrument will capture all of the aspects of visual performance that might interest audiences, any more than a single sonic instrument does. A model based around color, form, and motion does, though, provide a rich collection of visual elements that can be combined in ways that reflect much of the expressiveness of music. Learning to control the many dimensions of image is the challenge before us. The excitement implicit in that is not unlike that which must have greeted the inventors of the earliest rhythm instruments. So many possibilities; so much yet to learn and develop.

References

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