The Standard Instrument Space Libraries: Demonstrating the Power of ISEE

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ABSTRACT: In this demonstration, some of the design features of the first instrument space libraries accompanying the recently released Intuitive Sound Editing Environment 1.1 (ISEE) for Macintosh, a synthesis model-independent, perceptually-based synthesizer editor, will be shown. The standard instrument space libraries included with this release provide a transparent use of different synthesis models and different synthesis platforms to musicians and composers.

Introduction

ISEE is a perceptually-based synthesis editor in which timbre characteristics are controlled by means of instrument spaces which can be hierarchically organized into library documents according to their refinement and perceptual categorisation [Vertegaal and Bonis]. Each instrument space is made up by four timbral parameters. The first two of these parameters control the frequency contents (spectral envelope) of the sound and the last two to its development in time (temporal envelope): the *Overtones* parameter controls the spectral template; the *Brightness* parameter controls the energy balance between the lower and higher frequencies; the *Articulation* parameter controls the development of the overtones at the start of the sound and the behaviour of noise throughout the sound; and the *Envelope* parameter controls the speed of the temporal development of the sound. It is important to realize that these perceptual mappings constitute a design principle. Although it is not encouraged, the mapping of multiple synthesis parameters onto one of the dimensions of control is totally flexible, as is the hierarchical organization of the instrument spaces. During the design of the standard instrument space libraries, we found some compromises were inevitable.

The Standard Instrument Space Libraries

In order to provide musicians with a standardized way in which their timbres are organized, a standard hierarchy of instrument spaces was devised, modelling behaviour of traditional instruments. This way, the organization and control of timbral features can remain consistent between different synthesizers. The actual implementation of synthesizer parameters, however, is different for each standard library file and depends on the synthesizer's hardware capabilities. The design of each of these library documents involves the mapping of a set of synthesis model parameter changes onto the perceptual dimensions of each instrument space. Differences in operation of the underlying synthesis models should be made as transparent as possible to the user. For synthesizers with multiple synthesis models, one can use different combinations for each instrument space in the document. The standard instrument space hierarchy is shown in Figure 1.

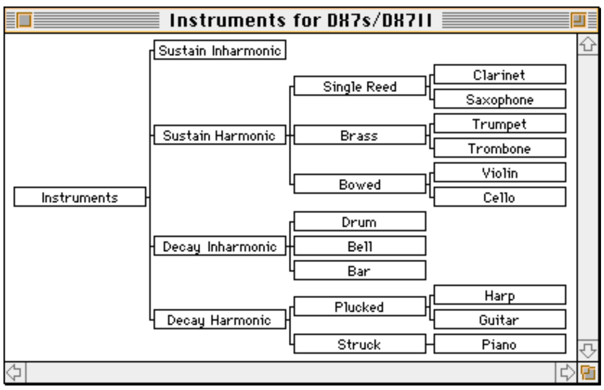

Figure 1. *The standard instruments library.*

Every hierarchy starts with one root instrument space, which contains a crude characteristic of instrument spaces further down the hierarchy. The first principle of hierarchical organization is envelope model. The next principle is harmonicity of spectrum, after which transient behaviour becomes important. Further classification roughly follows the traditional Sachs-Hornbostel model of instrument families. In the standard libraries, the root space is defined by a mapping of the Overtones from harmonic to inharmonic, Brightness from dull to bright, Articulation from a mellow transient to a harsh transient and Envelope from short decay to sustain. In the SY99 implementation, this is achieved by cross-fading between c:m ratios on the Overtones, manipulating the low-pass filter on the Brightness, the touch or breath sensitivity of the modulator relative to that of the carrier on the Articulation, and the decay rate on the Envelope. The modelling of a sustaining sound on the Envelope dimension as a sound with a infinitely long decay time turned out to be strikingly intuitive.

Each subspace is represented in its enclosing space by a position on the four perceptual dimensions. This way the layout of the instrument space is closely linked to the organisation of the hierarchy. The user can move to a subspace by positioning the parameters of the enclosing space to a position where the sound of the subspace is modelled, and pressing the zoom in button. In order to limit the depth of the hierarchy, and reduce the redundancy in timbral manipulation, the first two organizing principles were combined to produce the next layer of instrument spaces. This way, Envelope position and Overtones position in the root space can be combined to decide which of the four instrument spaces in the next layer will be selected when the user presses the zoom in button. In the Sustain Harmonic space, the definition of the Overtones parameter is similar to that of the harmonic part of the root space. The use of cross-fading, however, means its resolution is enhanced. In this space, the Envelope parameter controls the duration of the rise of the sound. Complete independence of the Articulation parameter from the Envelope parameter is difficult to achieve in this space. In the design of the next layer of subspaces, the most problematic compromise had to be made: from that point, the classification follows that of the Sachs-Hornbostel system. In order to be able to differentiate between the instruments in one family, however, pitch becomes an important criterion. This does not fit well with the model. As a compromise, Overtones was used in these spaces to control the range of the pitch, with a resolution of octaves. At the next layer, instrument control properties become predominant. The Overtones parameter in the Saxophone space maps from harmonically fused play to bluesy, inharmonic play. The Articulation controls the level of transient and persistent noise produced. In this space, real-time control of a DX7II with 6 operators produces striking instrument effects normally associated with physical modelling!

As a final example, in the Decay Inharmonic space the Overtones is used to organize the subspaces. The Articulation relates to the material of which the mallet is made, while the Envelope controls the decay time. Here, the DX7II implementation is a good example where a switch in synthesis model can be made almost transparent. In this implementation, FM is used in the Decay Inharmonic space, while additive synthesis is used for the Bar and Bell subspaces. This way, cross-fades between individual frequency components can be made in real time, to constitute subtle timbre differences on the Overtones dimension of the Bar space.

Conclusion

Although the conceptual design of instrument spaces is a complex creative process, the excellent integration of ISEE with existing editors such as Galaxy by means of MIDI Manager and Open Music System 2.0 provides easy means of experimentation with the ranges within which individual synthesis parameter should be changed on each dimension of an instrument space. After determining this range, the minimum and maximum parameter values are easily recorded and interpolated in-between in ISEE. Currently, standard instrument space libraries have been designed for the popular YAMAHA DX and SY series in this way. We will continue our effort to provide standard libraries for many more synthesizer models.

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References

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