TECHNIQUES OF ELECTROPHONY

by Eric Valinsky

In the past few years, considerable energy has been spent on the design and implementation of polyphonic synthesizer keyboards. It may be that much of this energy has been misspent, due to the limitations that polyphonic thinking places on the range of electronic music possibilities. Yet, polyphony is the traditional Western method of creating a rich sonic texture. This article will present a few alternate techniques which produce a rich musical texture without polyphonic keyboards or, subsequently, polyphonic thinking.

In designing analog systems, Robert Moog based his main control source on the traditional electronic organ keyboard. At the same time, Buchia developed a manual controller consisting of individually tunable, pressure-sensitive plates, thus avoiding the built-in tonal prejudices of the black-and -white keyboard. But the Buchla keyboard was awkward for playing Bach, and after Walter Carlos's commercial success, it was evident that the organ keyboard would become the electronic music standard. Indeed, by the time second and third generation synthesizers made their appearance, the synthesizer had become just another keyboard instrument.

Remember that at this time the most popular electronic music was arrangements of the music of J. S. Bach, whose polyphony had rendered the one-note keyboard obsolete. Hence the need for a truly polyphonic keyboard, leading, in the past few years, to limited polyphonic systems, by Oberheim, for example, and microprocessor controlled systems such as the E-mu polyphonic keyboard and the Strider Systems DCS1. The presents state of the art is the Polymoog, boasting a separate tone (not oscillator) for each key, thus conceptually returning to the electronic organ.

Is the Polymoog fully polyphonic as it is claimed to be? A broad, classical definition of polyphony is:

Music written as a combination of several simultaneous voices [parts] of more or less pronounced individuality.[1]

In electronic music terms, a truly polyphonic synthesizer must allow the performer to (1) produce many different sounding voices simultaneously and (2) control completely the assignment of a particular key to a particular voice at any instant of time.

Both the Polymoog and the Oberheim Polyphonic meet requirement (1), though in different and limited ways. Both systems fail requirement (2), which is the hard part. The limited key assignment capability of each system forces the performer to use the instrument to produce a homogeneous chordal structure termed *homophony*. Thus the Polymoog and the Oberheim are essentially *homophonic* synthesizers.

So far, quite a bit of space has been devoted in this article to the concept of polyphony and it has not been space well allocated. The traditional concept of voicing itself is to blame, in that it limits the electronic composer to thinking about notes, rather than the more general event concept outlined in the author's last article. Much of the potential of synthesizer technology is being wasted. And in spite of their limited application, multivoiced systems are expensive, since each voice requires a duplicate set of components.

So enough talk of polyphony and homo-

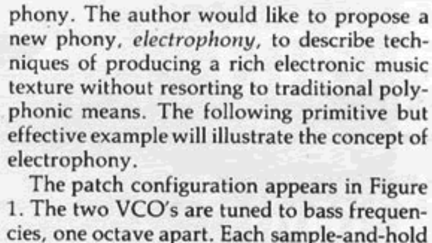

Figure 1: An electrophonic patch.

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phony. The author would like to propose a new phony, *electrophony*, to describe techniques of producing a rich electronic music texture without resorting to traditional polyphonic means. The following primitive but effective example will illustrate the concept of electrophony.

The patch configuration appears in Figure 1. The two VCO's are tuned to bass frequencies, one octave apart. Each sample-and-hold samples its own noise source, and the Q of the filters is adjusted almost to the point of oscillation, thus producing two sets of randomly occurring overtones. Polyphonically speaking, the patch is two voiced, each VCO-VCF combination comprising one voice. Listeners have reported hearing at different times three voices, namely the two sets of overtones plus one fundamental; four voices: two overtone sets and two fundamentals;two voices as above; or two voices with the fundamentals as one and both overtone sets as the other. Sometimes the entire patch is heard as one voice. This

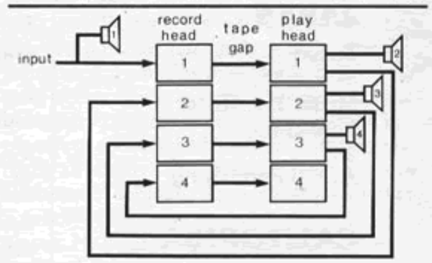

Figure 2: Quad rotating tape echo.

ambiguity of perceived voicing is characteristic of electrophonic techniques.

A few additional examples of electrophony will conclude the article. The first technique is adapted from the music of J.S. Bach, the unwitting perpetrator of synthesizer polyphony. By carefully selecting pitches, Bach was able to make a single voice sound like two to three voices. This technique of *polyphonic simulation* can best be electronically implemented by rapidly cycling a sequencer controlling a sound source. Pitches can be selected which cause many voices to be perceived. A sequencer of many more than eight stages is preferentially used.

A less predicatable, sequencerless method utilizes many sub-audio square waves controlling a sound source, thus producing discrete pitches. If the square waves are tuned to slightly different frequencies long patterns of changing rhythms result.

The technique of *homophonic simulation* is borrowed from Ronald Pellegrino. A fixed sine wave tuned to, say, C an octave above middle C, is fed into one input of a balanced modulator. A waveform, pitchcontrolled by a keyboard (Pellegrino used a live soprano), is fed into the other input.The balanced modulator output and the two inputs are monitored simultaneously. Correct pitch se-