BOB MOOG
ON SYNTHESIZERS
Monophonic Synthesizer Player Controls

IN LAST MONTH'S COLUMN I LISTED four basic facilities of monophonic musical instruments: 1) rapid, accurate pitch determination (including pitch-bending); 2) continuous control over loudness, as opposed to just amplitude or volume control; 3) intimate control over attack shaping; and 4) ability to produce a pleasing overall tone color. All widely used acoustic monophonic instruments incorporate all of these facilities; it is clear to me that electronic monophonic instruments will also have to include these features in order to be taken seriously and to be widely accepted in the long run. Commercial monophonic performance synthesizers have been on the market for just under a decade now. Let's see how they stack up with regard to the basic features.

Of the four basics listed above, three have to do primarily with an instrument's control interfaces—those parts of the instruments that the player physically touches and manipulates in order to introduce and shape the tone. All acoustic monophonic instrument control interfaces have evolved into unique, complex, highly specialized forms that fit the player's control capabilities. In contrast to this, monophonic synthesizer control interfaces are, with very few exceptions, made from components that were not originally designed for monophonic electronic instruments. For instance, virtually all monophonic synthesizers use keyboards that were originally designed for electronic organs. By and large, these keyboards are a useful and efficient means of determining pitch. But they may not be optimum. Considering the amount of weight and space they occupy, they do not provide anywhere near the efficiency of information transfer (from player to instrument) of, say, a guitar neck. By this I mean that a guitar neck allows a musician to both select *and* bend pitch of up to *six* separate tones, whereas an organ-style synthesizer keyboard, by itself, does not allow pitch-bending and, in the case of monophonic synthesizers, only allows one or two independent notes to be played at a time. The point is that an optimum monophonic synthesizer keyboard would not be based on a standard organ keyboard design, but would probably be smaller and more touch-sensitive.

During the past few decades many such keyboard instruments have been built and offered for sale. One example is the Solovox, a monophonic built by Hammond during the Golden Age of Vacuum Tubes (the GAVT). The Solovox keyboard utilized the same key spacing as the piano or organ, because it was designed to be clamped onto, and played with, these more traditional instruments. However, the Solovox's keys were much shorter than piano or organ keys. Keyboard players need several inches' key depth when they play polyphonically. Fingers reach in different directions, and they land on different parts of the keys of polyphonic instruments. However, there is no good reason I can see that a monophonic keyboard has to be as deep as a polyphonic keyboard.

Another of the GAVT instruments, the Ondioline, not only used a keyboard of short keys but employed a 'soft' spring keyboard mounting so that sideways pressure on a key would move the keyboard and could be used for pitch-bending. More recently the SynKet, a small synthesizer built on a custom basis in the '60s by Paul Ketoff in Rome, had three small tiered keyboards. Each keyboard was spring-mounted to move both sideways and vertically. Thus each keyboard had two independent degrees of touch-sensitivity. And the whole SynKet assembly of three keyboards was smaller than a single non-touch-sensitive contemporary synthesizer keyboard.

Why, then, do none of the currently available monophonic synthesizers use specialized touch-sensitive, appropriately-sized keyboards? As with most other synthesizer control interfaces, keyboards are expensive to design and tool up for. Keyboard manufacturers (there is only one in the United States, and a mere handful throughout the rest of the world) will design a new keyboard only when they are sure they will sell enough to at least recover their engineering and tooling costs. Synthesizer manufacturers have not yet been willing to place large orders for small, touch-sensitive synthesizer keyboards, for, as they point out, electronic instruments with small, touch-sensitive keyboards were never very popular with musicians in their time. Instrument manufacturers also point out that a musician who undertakes to master a new type of keyboard will have to put in many hours of practice. This means that not all players of conventional keyboard instruments will be able to transfer their hard-learned technique to a new instrument, and that sales of that instrument will therefore suffer, regardless of the instrument's long-range musical value. Thus, the use of conventional electronic organ keyboards in monophonic performance synthesizers is dictated at the present time by a combination of economic considerations (nobody wants to be the first to spend all that money on tooling) and long learning time (many synthesizer players are just beginning to learn their way around the simple pitch-bending devices that are now available). Conventional organ keyboards do have their advantages, and will serve as useful points of departure as musical instrument designers develop synthesizer keyboards during the coming decades.

How about pitch-bending devices (see Synthesizer Basics—"Pitch-Bending, Part I: Hardware," in *CK*, May '79)? In most music, we perceive the center pitch (what note is being played) as something entirely different from the amount of pitch-bend. Technically speaking, both are frequency variations, but the arrangement of center pitches forms the melodic *structure*, whereas the contours of pitch-bend are expressive elements that have more to do with *color* and *texture* than with structure. Thus it is reasonable in a monophonic instrument to have one device that is used to determine center pitch (the keyboard) and another that is used to bend the pitch.

The ideal pitch-bender would respond precisely and smoothly to small as well as large hand movements. It would allow the hand to move back and forth rapidly (to produce vibrato) as well as make slow, delicately shaped pitch bend contours. It would not tire the hand out, nor would it ever stick, go out of tune, or otherwise wear out. None of the pitch-benders in current use meet all the specifications of our ideal pitch-bender, but several come close. The simplest pitch-bending mechanism is a standard pot-and-knob. The feel of this type of pitch-bender depends how smoothly the pot itself turns, what the shape of the knob is, and where the knob is located on the instrument. Pitch-benders of this type generally require two or more fingers on the knob, which is okay for slow pitch-bends but tends to limit the accuracy of faster bends.

Next in mechanical complexity is what I will call the "modified pot-and-knob," where the conventional knob is replaced by a large wheel or bat handle. These benders have the advantage of being operable with one finger at a time, and therefore being capable of fast, yet precise bends. As two of the very few control interfaces designed from scratch especially for synthesizers, the ribbon and the pressure pad are pitch-benders that allow the fastest pitch-bend. Because of the small motion involved, pressure pads are tops in speed, while the ribbons are tops in accuracy because of the linear pitch/distance relationship.

Summing up, we see that the keyboard/pitch-bender complements of most currently-available synthesizers meet basic requirements for pitch control in monophonic musical instruments. Future generations of synthesizers will undoubtedly include unique keyboards and more precise, smoother-acting pitch-benders.

Next month's column will peer into loudness and attack shaping, and will then have a look at some synthesizer control accessories that are now being offered.