LIVE PERFORMANCE

LIVE PERFORMANCE AND MIDI

Introduction

Question: How do you perform electronic music without tape?

Answer: Take away the tape.

Since a great deal of early electroacoustic music was created in radio stations and since radio stations used tape recordings in broadcast, it seemed natural for electroacoustic music to have its final results on tape as well. But music, unlike radio, is traditionally presented to audiences in live performance. The ritual of performance was something that early practitioners of EA did not wish to forsake, but they also quickly realized that sitting in a darkened hall with only inanimate loudspeakers on stage would be an unsatisfactory concert experience for any audience.

HISTORY

The Italian composer Bruno Maderna, who later established the Milan electronic music studio with Luciano Berio, saw this limitation almost immediately, and in 1952, he created a work in the Stockhausen's Cologne studio for tape and performer. “Musica su Due Dimensioni” was, in Maderna’s words, “the first attempt to combine the past possibilities of mechanical instrumental music with the new possibilities of electronic tone generation.”
Since that time, there have been vast numbers of EA works created using this same model of performer and tape. On the one hand, such works do give the audience a visual focal point and bring performance into the realm of electroacoustic music. However, the relationship between the two media is inflexible; unlike a duet between two instrumental performers, which involves complex musical compromises, the tape continues with its fixed material, regardless of the live performer’s actions.

50s + 60s

1950s and 60s

Karlheinz Stockhausen was somewhat unique in the world of electroacoustic music, because he was not only a pioneering composer of EA but also a leading acoustic composer. Many other acoustic composers of the period rejected electroacoustic music, at least for the time, since it did not offer them the combined control of pitch material with timbral complexity—essentially the divergent qualities at the time between musique concrète and elektronische musik.

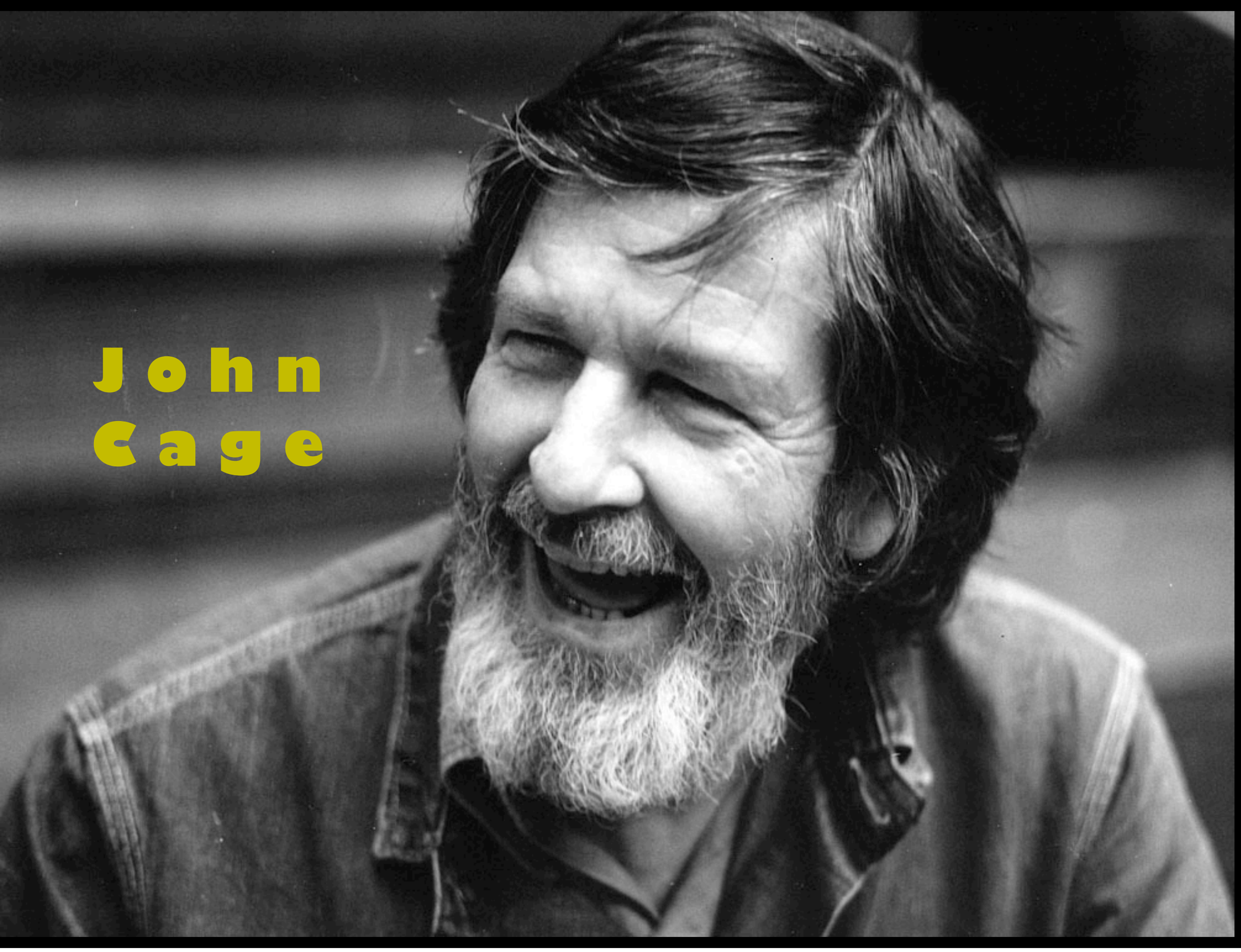
It goes without saying that there were, and still are, divergent views of electroacoustic music, particularly with respect to the notion of a final tape (or other fixed media, such as CD). These notions are usually related to the conception of performance. Many composers of the European Art Music tradition, at least those writing acoustic music, viewed performance as secondary to the results on the printed page. For them, music was the abstract relationship of pitches on paper, and the sonification of these pitches was a by-product. This is one of the tenets of modernism, the paradigm that dominated artistic practice for a large part of the twentieth century.

Precision

Some electroacoustic composers, such as Milton Babbitt, saw the final tape as an extension of the printed page, as a precise and singular aural realization of their abstract conceptions. In their tape works, they could present their compositional culmination directly to those who cared to listen without the alterations created by performers' interpretations.

Performance

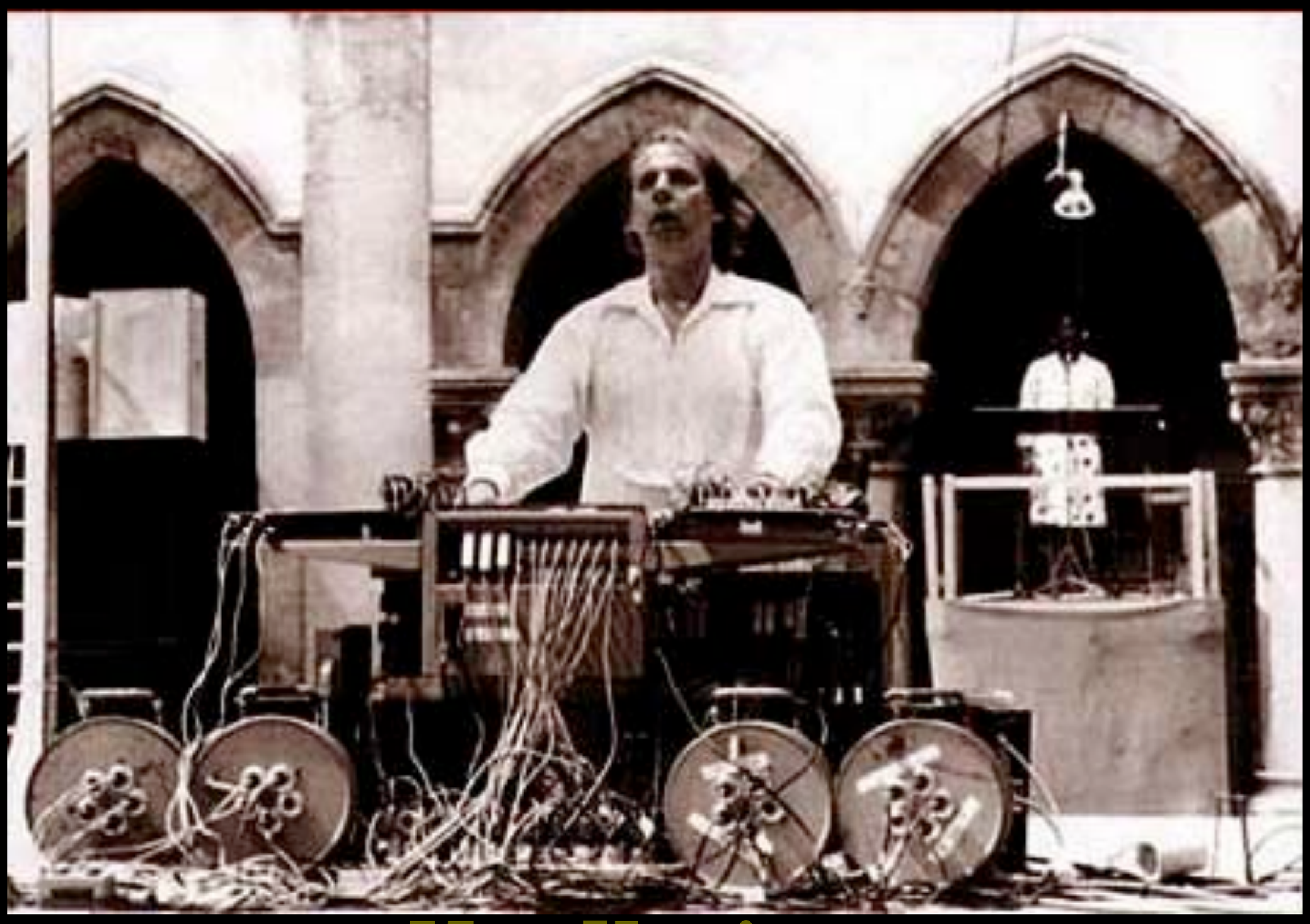
Other composers were very much interested in performance, in communicating directly with the audience in what they saw as a supportive relationship. Composers such as John Cage saw the electroacoustic resources as new instruments that could be used in performance, and took them out of the studio and into the concert hall.



JOHN CAGE

Earlier, we noted Cage's early experiments in live performance, in pieces such as "Imaginary Landscape." Cage was considered an experimentalist, and those early uses of turntables and oscillators in concert were extensions of that notion. By the 1950s, however, electronic music was no longer experimental but was a viable artistic medium. He therefore revisited the idea of live electronics, and his 1960 composition "Cartridge Music" was an attempt "to make electronic music live." True to many of Cage's works, the idea is simple: phonograph cartridges are used as contact microphones against a variety of objects.

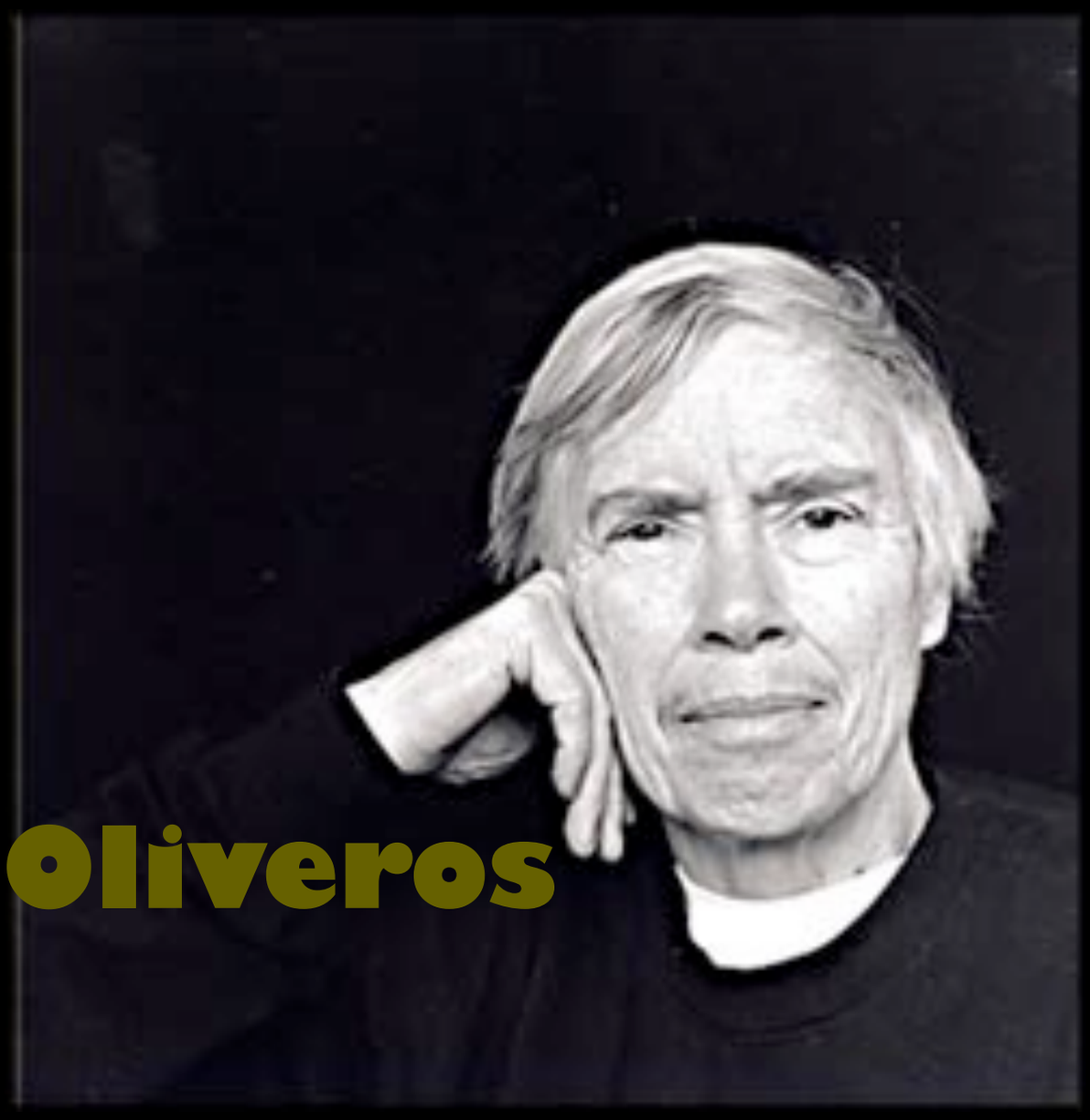
The title "Cartridge Music" derives from the use of cartridges—that is, phonograph pick-ups into which needles are inserted for playing recordings—in its performance. Contact microphones are also used. They are applied to chairs, tables, wastebaskets, and so on, and various suitable objects (toothpicks, matches, slinkies, piano wires, feathers, etc.) are inserted into the cartridges. Both the microphones and the cartridges are connected to amplifiers that go to loudspeakers, since the majority of the sounds produced are small, and require amplification in order to be heard (Cage in Chadabe).



Karlheinz Stockhausen

KARLHEINZ STOCKHAUSEN

Most of Stockhausen's works in the 1960s used electronics and, above all live electronics (i.e., the use of electronic equipment in concert to modify the sound of amplified instruments). In Kontakte, an earlier work (1959–60), live sound modification does not occur, and the performers play notated music to an accompanying tape. However, Stockhausen does not envision this relationship as soloists with accompaniment. Instead, the performers create a parallel and simultaneous performance to the tape. Their actions are, at times, synchronised and related to the tape, but the live element is seen as extending the tape into the concert hall.



Pauline Oliveros

PAULINE OLIVEROS

Typically, American composers did not work out of radio stations as did their contemporaries in Europe. And those composers not associated with universities had to buy their own equipment or seek it out from unlikely sources.

In San Francisco in the early 1960s, some young composers pooled their equipment, but they still lacked some essential resources. Pauline Oliveros explains her own resourcefulness:

I would record acoustic sounds using cardboard tubes as filters. I'd put a microphone at one end of a cardboard tube and a sound source at the other. I used different sized tubes to get different filter characteristics. Sometimes I'd clamp a sound source to the wall so the wall would act as a resonator and then record it at 3 3/4 or 7 1/2 inches per second. I used a bathtub as a reverberation chamber. (Oliveros in Chadabe). Pauline Oliveros, Terry Riley, Morton Subotnick (to name some of the more well-known composers), and others began exploring live music in earnest in connection with their newly established San Francisco Tape Music Center. All of these composers were very interested not only in performance but also in performance art. For example, one work of Oliveros's, entitled "Seesaw Version," involved a seesaw that spun around slowly on a Lazy Susan with a mynah bird suspended overhead (she hoped the bird would make sounds). It should be noted that the hippie era was beginning in San Francisco at this time.

Terry Riley

TERRY RILEY

Terry Riley, also associated with the San Francisco Tape Music Center, was essentially a performer, and his electroacoustic music represented a method of multiplying himself in performance. Using an organ and a soprano saxophone, Riley would process his performance through complex tape delays to create multilayered compositions.

Terry Riley, Poppy No Good (excerpt) (1969)

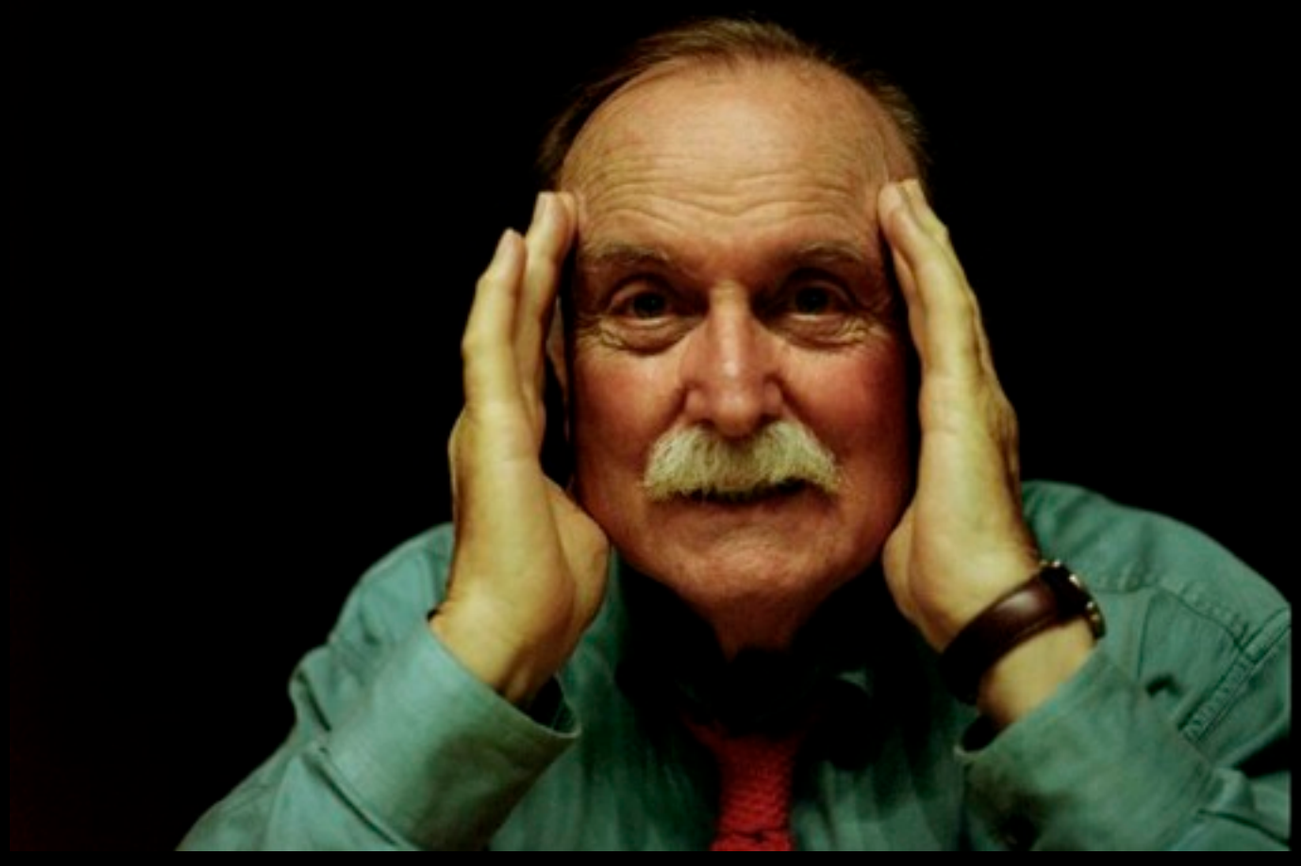
Riley was one of the forerunners of minimalism, an important technique and aesthetic in twentieth-century music. One concept used in music such as this is the removal of the distinction between background and foreground; everything moves slowly and could be deemed background. “Poppy No Good” and works like it require a different mode of listening. On hearing this work, is it necessary to explicitly state these intentions, or can you sense them as the music progresses? Does this type of listening appeal to you, or does the music seem, for lack of a better word, boring?

DAVID TUDOR

In New York, David Tudor created unique electronic circuits to provide real-time synthesis for dance performances by Merce Cunningham's troupe. Since Tudor was creating an accompaniment to dance, he wanted the flexibility of creating the sounds live but without cumbersome electronic studio equipment. Following John Cage's model, Tudor built small, sound-producing instruments that he could take with him as the show toured; these devices afforded him "flexibility, portability, and cost, but it was also because I could get the sound I wanted to hear."

In "Rainforest," Tudor calls for

. . . any objects, any number of objects, and any sounds, with contact microphones (in addition to the contact loudspeakers) attached to the objects to amplify their vibrations. The microphones are releasing the sound of the objects—you put the sound through a physical material, so that the physical material transforms the original source which is fed into it, and if you can manage to amplify that sound with a microphone, you release the harmonic content which the material gives to it. (Tudor in Chadabe)



Alvin Lucier

ALVIN LUCIER

Alvin Lucier was interested in the “simple use of technology” so that its end result was “revealing things.” He would create a task that explored a very specific acoustical property, such as beat frequencies, in such a way that it produced results that were “both unexpected and clear.” Lucier stated that he was always interested “in cause and effect, when the effects are very surprising.”

In “Music on a Long Thin Wire,” Lucier extended a wire across a large room and clamped the ends to tables. The ends of the wires were connected to the speaker outputs of a power amplifier so that the wire would vibrate as a speaker normally would. A sine wave oscillator was then connected to the power amp, which would cause the wire to vibrate. Wooden bridges, like those on a guitar, were inserted under the wire at both ends so that it could freely vibrate. Contact microphones were placed on these bridges, and they would pick up the vibrations of the string; the output of the microphones was sent to a playback system.

By varying the frequency and loudness of the oscillator, a rich variety of slides, frequency shifts, audible beats, and other sonic phenomena may be produced. (Lucier in Chadabe)

Alvin Lucier, Music on a Long Thin Wire (excerpt) (1970)

Does knowing the process behind this piece make it more enjoyable? Or can you appreciate this work for its aural results alone?

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David Behrman

DAVID BEHRMAN
In the mid-1970s, David Behrman used a simple, single-board computer to control oscillators, and pioneered interactive live systems. “On the Other Ocean” is an improvisation for bassoon and flute (on six pitches) and interactive electronics.
The instrumentalists improvise on the pitches. The music is picked up by microphones and fed to six pitch sensors, which decipher whether a particular frequency was played. These devices then send their signals to a primitive home-built computer, the Kim-1, which can analyze the order and timing of the events. The computer has a large number of predetermined chords programmed into it, and it determines which chord to play and sends this information to a home-built synthesizer.
The relationship between the two musicians and the computer is an interactive one, with the computer changing the electronically produced harmonies in response to what the musicians play, and the musicians influenced in their improvising by what the computer does. (Behrman in Chadabe)

On the Other Ocean

David Behrman, On the Other Ocean (excerpt) (1978)
This meditative and pleasant-sounding work is completely different from the acerbic sound of David Tudor's "Rainforest." (Tudor was based in New York, Behrman in California.) Could composition location influence the success of an electroacoustic work?
Compositions such as Behrman's marked an important point in electroacoustic music: the convergence of analogue synthesizers, which had progressed in complexity (see the previous unit) and digital computers, which had become affordable (see Units Eleven and Twelve) in live-performance situations. As we saw in the previous unit, synthesizers had become commercially available and portable; therefore, composers interested in live electroacoustic music no longer needed to build their own circuits and sound-producing devices.
Combined with the wealth of material available, with live processing and the use of prerecorded tapes, live electronics bloomed as a performance art.

Live Musique Concrét?

Live Musique Concréte?
Although it was possible to bring tape recorders on stage, most practitioners of live electroacoustic music saw the tape recorder as a fixed medium, and counter productive to their goals of performance. And although there were pieces that called for live recording, editing, and playback on stage, those were few and far between. Musique concréte, which relied upon the recording of sound objects and their manipulations, was essentially a studio-based medium.
For this reason, and as we saw in the previous section, those composers interested in live electroacoustic music gravitated towards electronic sources. Oscillators, filters, envelope generators, and other signal processors could all be controlled, to an extend, in a performance situation. Thus, it was the creation of the synthesizer in the late 1950s and early 1960s that allowed live electroacoustic music to dramatically rise in importance.

The State of Synthesizers in the 1970s
Three phenomena arose by the late 1970s, changing electroacoustic music:
Standardization (to an extent)
Popular use
Microprocessor control.

Standardization

Standardization

By the mid-1970s, most synthesizers (whether used in the studio or in live performance) were voltage controlled. The frequency of an oscillator could be controlled by a varying voltage. The voltage could come from another oscillator or from a control device such as a keyboard. It was therefore conceivable to interconnect the different synthesizers in your studio. However, different manufacturers used different amounts of voltage to control their modules. For example, most synthesizers used one volt per octave (adding one volt to an oscillator would make it play one octave higher). But Moog systems used 1.2 volts per octave. Thus, connecting a keyboard controller from an Arp synthesizer to a Moog would not produce desirable results (at least in terms of oscillator tuning!).

popular use

Popular Use
With the use of synthesizers in some key recordings, including Walter Carlos's Switched-On Bach(1967), Emerson, Lake, and Palmer's "Lucky Man" (1970), Pink Floyd's Dark Side of the Moon (1973), and Roxy Music/Brian Eno recordings, synthesizers were beginning to be used in all forms of popular music. The electronic sound became increasingly familiar and commercially desirable, and so the market grew. New companies were formed and new synthesizers were developed, each with its own improvements, sound, and style.
By the late 1970s, certain synthesizers had become known for certain sounds (based on their hardware circuits):
Fat bass line on MiniMoog
Roland string sound
Thinner soloistic sound on Arps, etc.
Keyboard musicians began to accumulate many different synthesizers in order to have access to their individual sounds.

Jazz/funk keyboardist Herbie Hancock with his keyboard setup for his 1978 Sunlight tour. Also, doubling of synthesizer lines in live performance became popular for a “phatter” sound. Doubling required the performer to play the same melodic material on both synthesizers, using two hands, a technique perfected both visually and musically by Keith Emerson.

With the emergence of Japanese companies, mass-production techniques became used in the manufacturing of electronic instruments, making them even more affordable. You, too, could afford the same instrument that your favourite keyboardist used on his or her latest recording.

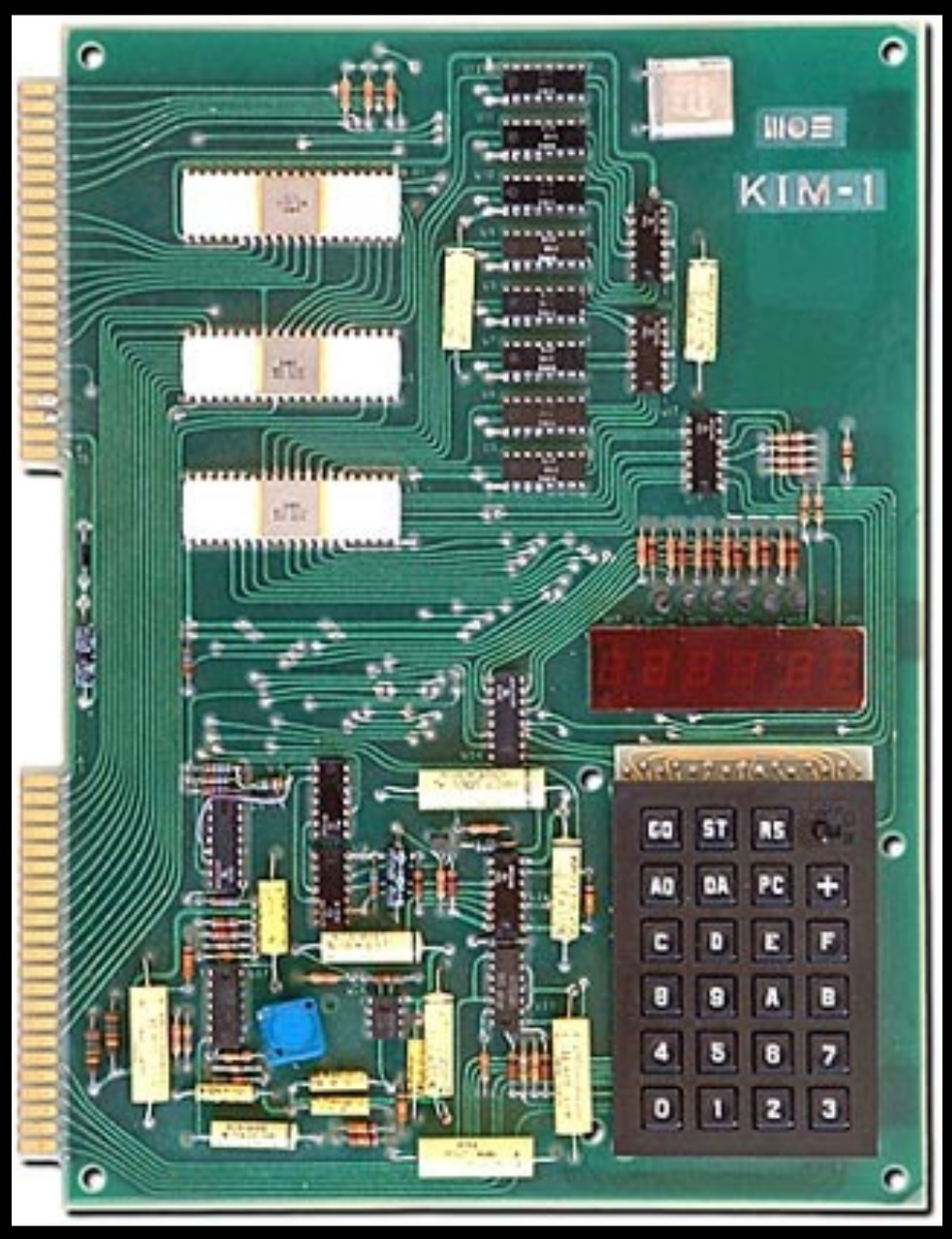
sequencers, drum machines

Sequencers and Drum Machines

Early Buchla synthesizers had a unique module on them: a sequencer. This module simply stored different voltages, which could be recalled later. Usually, it had a clock—a device that repeated evenly in time—trigger these voltages one at a time, in order. Because the number of stored voltages was limited (usually eight, twelve, or sixteen) and the clock was almost constant, the result was a repetitive rhythm. This proved a popular concept since it allowed a musician to have the sequencer play one part (often a repeating bass line), while he or she played another (the melody or an improvised line).

(Jon Hassell, Before and After Charm (1980), Klaus Schulze, Melange (1977)

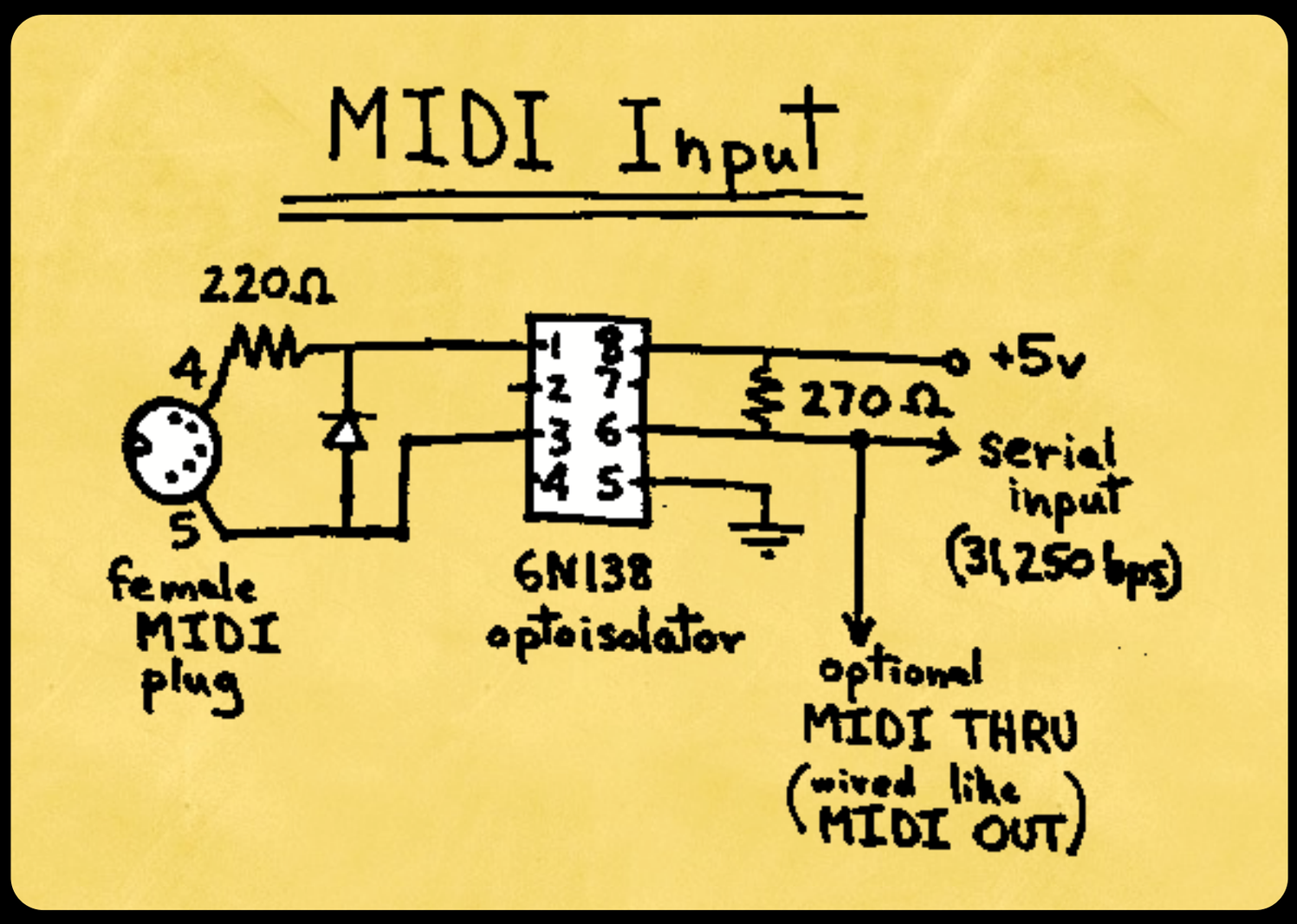
microprocessor control



Microprocessor Control

By 1978, microprocessors began to appear in electronic music instruments. The first synthesizer to have one was the Prophet 5, which used it to scan the instrument's knobs and store their positions in memory for later recall. (Sounds were still produced via analogue circuits.)

Roland produced a system called DCB (digital control bus), which allowed different Roland components to connect to one another and control each other. But it could not connect a Roland to other equipment.



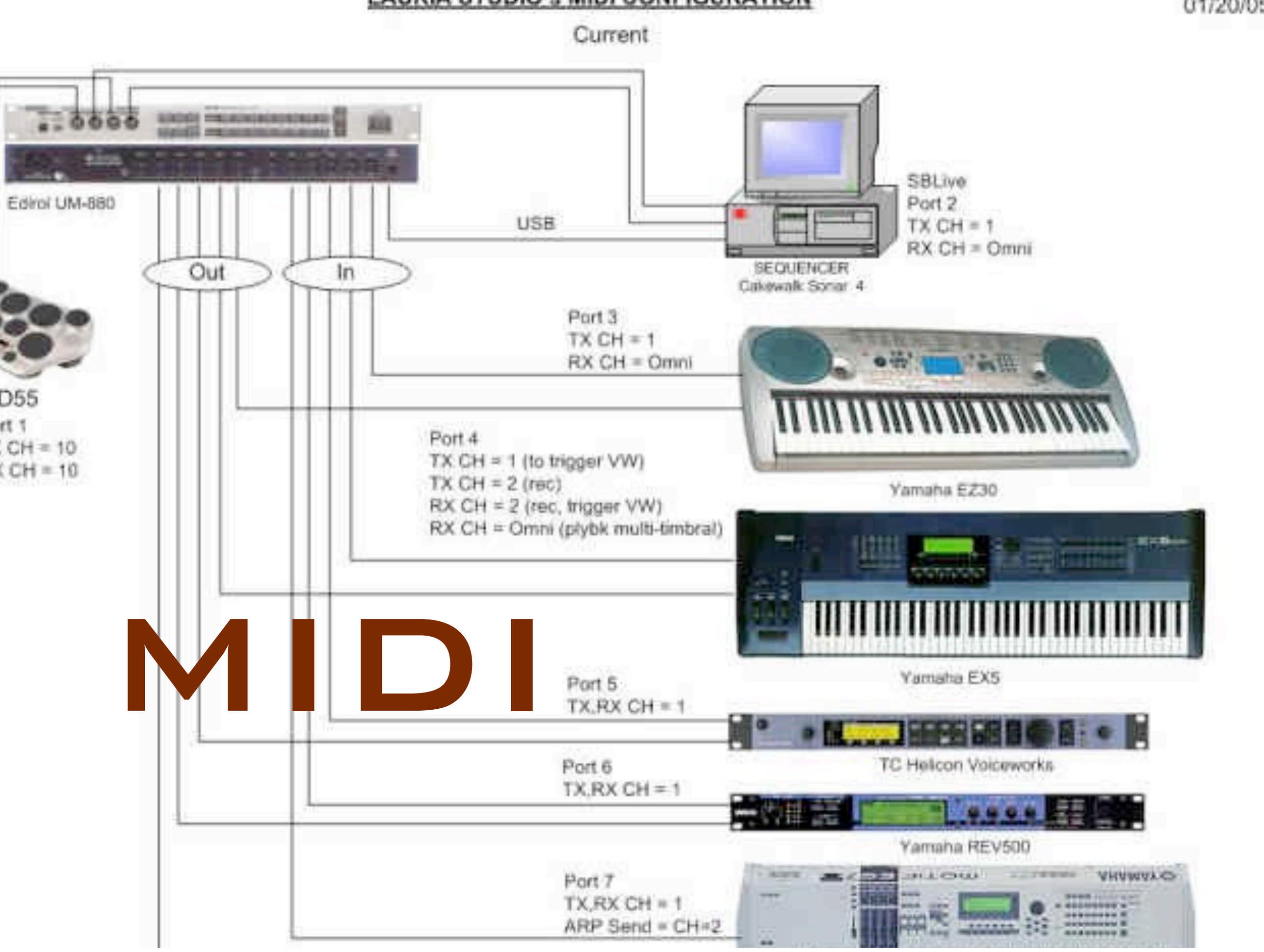
MIDI

The Evolution of a Standard

At the 1981 annual convention of National Association of Music Merchants (NAMM), nearly all of the Japanese and American companies involved in producing electronic instruments were present. Japan was represented by Kawai, Korg, Roland, and Yamaha, while the US was represented by Oberheim and Sequential Circuits. (It is interesting to note that only the Japanese companies are still in business.) What began as informal discussions between the engineers evolved in a few short months into a standard:

MIDI is the standard method of digital communication between musical instruments.

The primary benefit of the standard was that it allowed the connection of any number of devices, regardless of their manufacturer, into a single system that a single performer could control. The flexibility would allow composers to build up their systems one device at a time, and to interchange items within it without disturbing the system itself.



MIDI—The Musical Instrument Digital Interface

This standard is based entirely upon the current model of synthesizer use in popular music: one musician playing a single keyboard synthesizer, and the performance information (what notes are being played, how hard they are pressed, and other gestural information) being sent to the synthesis engine of other synthesizers.

Other benefits sought at time of creation include:

Hardware extensibility—the ability to expand the synthesizer in the future with software(rather than hardware) modifications

Protection from obsolescence—the recognition that musicians did not want their investments to become obsolete as soon as a company produced a new instrument

Computer interfacing—which forward-thinking musicians and engineers realized was on the horizon.

MIDI

The MIDI controller, or master, sends messages through a connecting cable to a receiver, or slave, which should interpret them as if they had been generated by the receiver's controller itself.

These messages can be considered gestures, specifically performance gestures. Although gesture in performance can be extremely complex, the gestures interpreted and sent by MIDI are limited:

Which keys are pressed and released

How much the controller wheels are moved (i.e., a modulation wheel or a volume slider)

Which switches are pressed (i.e., a sustain pedal or a patch change).

MIDI

Perhaps the single most important distinction that must be remembered about MIDI, and one of the main reasons for its evolution and success, is the following:
MIDI is an event-based network, not a sample-based one—no sound information is being sent.

Even with the limited personal computer resources available in the early 1980s, MIDI was achievable.
Considering the difficulty of achieving any sort of standard in technology, MIDI was an amazing accomplishment. That it happened at all may be credited to the fact that it was cheap to implement, and had indirect benefits for manufacturing companies. Therefore, there was no incentive for companies to offer competing and inferior implementations in an attempt to crush the agreed-upon standard.

32.25 kilobyte serial interface

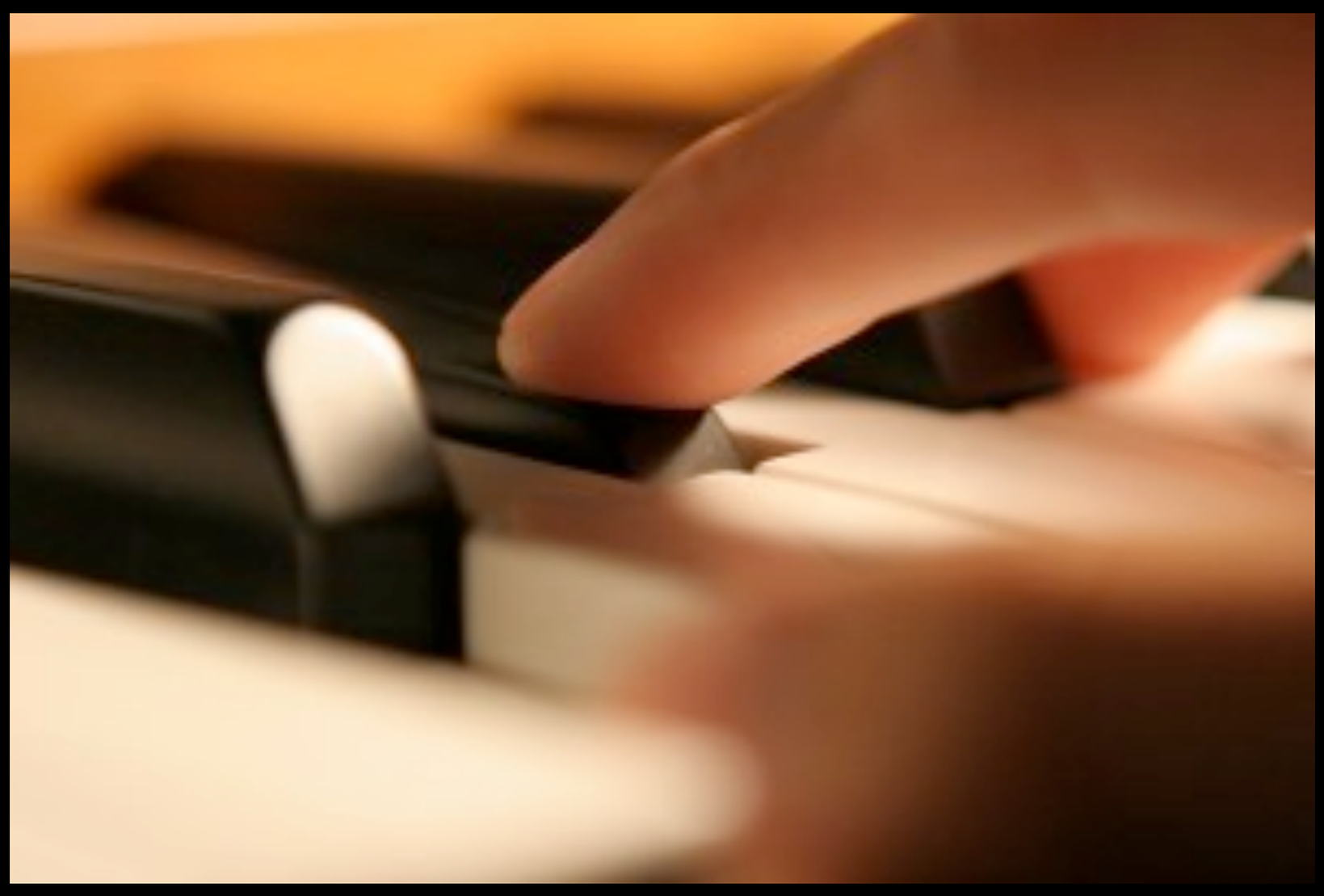
1 MHz clock / 32

MIDI Basics

The information that MIDI was supposed to communicate was based upon the commercial use of synthesizers at the time. MIDI is a combination of a physical protocol and a software standard. Among its physical features are:

32.25-kilobyte serial interface communication protocol. This speed is based upon a one-megahertz clock, commonly available at the time, divided by thirty-two. Combined with the data structure, it allowed for several hundred events per second, which was thought adequate for performance analysis. Slower serial communication was chosen over a faster parallel method because the necessary hardware was less expensive.

Inexpensive cable and connectors. Using a DIN plug that was common in European stereo systems (but not in North America) allowed for an existing connector that could be uniquely identified. A typical MIDI cord was to cost $5.00 retail.
The cable lengths were to be reliable for up to fifty feet/fifteen metres. Why (it was thought at the time) would you want to connect two devices that were more than fifty feet apart?
Robust connectors and interface. With some foresight, it was realized that MIDI would be used by musicians in performance situations that would include, for example, nightclubs as well as studios. Unlike stereo or studio equipment, MIDI instruments would have to be connected and reconnected, possibly several times a night.



The software protocol was optimized for conventional music, and based upon events. An example event would be a note-on, when a player triggers the beginning of a note by pressing a key.

Each note-on event would have a dynamic associated with it: that is, how loud the player intended the note to be. This is a logical borrowing from the acoustic model of the piano, where pressing a piano key harder makes the hammer mechanism strike the string harder. A measure of key pressure turned out to be more expensive than a measure of the key's downward speed; therefore, dynamics are normally attributed to velocity.

Notes are based upon the clavier-style (black and white) keyboard—twelve notes per octave—but the normal seven-octave piano range is extended to over ten octaves (127 notes).

127

This number, 127, is used throughout the MIDI specification although it has no musical meaning. The reason relates to the data structure itself. Events are transmitted in a ten-bit (ten ones or zeros) stream. The first bit signifies the start of the event, and the last bit signifies the end. This allows the receiving device to parse the data and check for errors in transmission. Of the remaining eight bits, the Most Significant Bit (first one) indicates the data type (what kind of message it is), so effectively, MIDI deals with values from zero to 127 (seven bit).

Note-on	*When a note is initiated, which note, and the velocity (how fast it is moving=how "hard" it is struck.*
Note-off	*When a note is stopped. Not used - instead a Note-on with velocity = 0 means note-off.*
Program Change	*Change a preset (usually timbre setting or patch configuration).*
Continuous Controller	*any controller such as modulation wheel, volume pedal, slider, knob, etc.*
Pitch Bend	*bend the pitch up or down from original.*
Aftertouch	*additional keyboard pressure after the note has been initiated.*
System Exclusive	*A wide variety of information to specific devices by manufacturer/model.*

MIDI Applications— The Personal Computer

By reducing performance information to a few well-defined items and standardizing how this information is sent and received, it immediately became possible to use a computer within the MIDI chain. While computers had been used within live electronic music before MIDI (for example, David Behrman's work), performers needed special hardware and specialized knowledge of electronics to create such interfaces. With MIDI, the protocol for communicating between instruments existed and the hardware (in terms of the synthesizer) was commercially available. What was missing was the software.

The real question was what was to be done with the MIDI information.

Computer Music vs. Electronic Music Computer Music vs. Electronic Music Computer Music vs. Electronic Music Computer Music vs. Electronic Music Computer Music vs. Electronic Music Computer Music vs. Electronic Music

Computer Music vs. Electronic Music

MIDI was the convergence of two formerly divergent fields of electroacoustic music: electronic musicand computer music (discussed in Units Eleven). The people involved in the two areas were distinct, and generally made their choices for different reasons. Remember that computer music was, up to that time, being made in large research institutions, and the people involved were academics and scientists. The electronic music field was populated by a variety of musicians and engineers.

Electronic music offered an immediacy in its working methods that differed from computer music. Computer music concentrated on synthesis; the software focused on the detailed specification of sound parameters and offered little in the way of performance definition. Electronic music, on the other hand, was very much about performance, not only in the use of synthesizers onstage in live situations but also in the studio. For example, Morton Subotnick's studio recordings were interactions between him and the Buchla synthesizer that he would record in multiple tracks. Unlike musique concrète, there was little in the way of processing of abstract material in electronic music; instead, the processing was part of the patch that was played on the synthesizer.

Furthermore, the MUSIC-N languages, the dominant software used in computer music up to that time, were non-realtime; after specifying every parameter, users had to wait until the computer calculated the sound. While this type of music production appealed to those composers interested in new timbre construction, most musicians interested in electroacoustic music appreciated the immediacy of hearing the aural results of their manipulations.

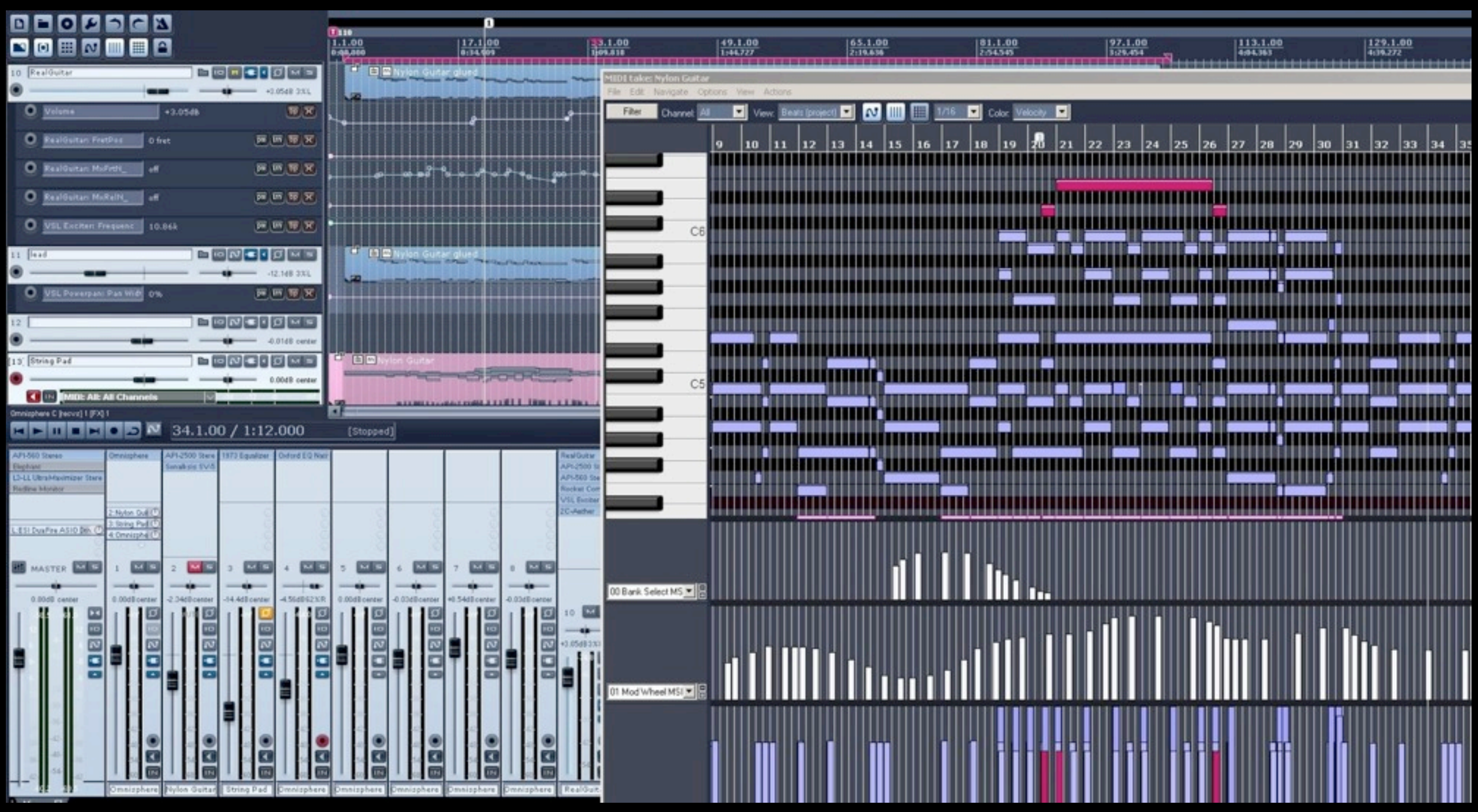
Therefore, despite the fact that there was no clear precedent, successful MIDI software had to offer an extension of electroacoustic musicians' existing working methods.

The Sequencer

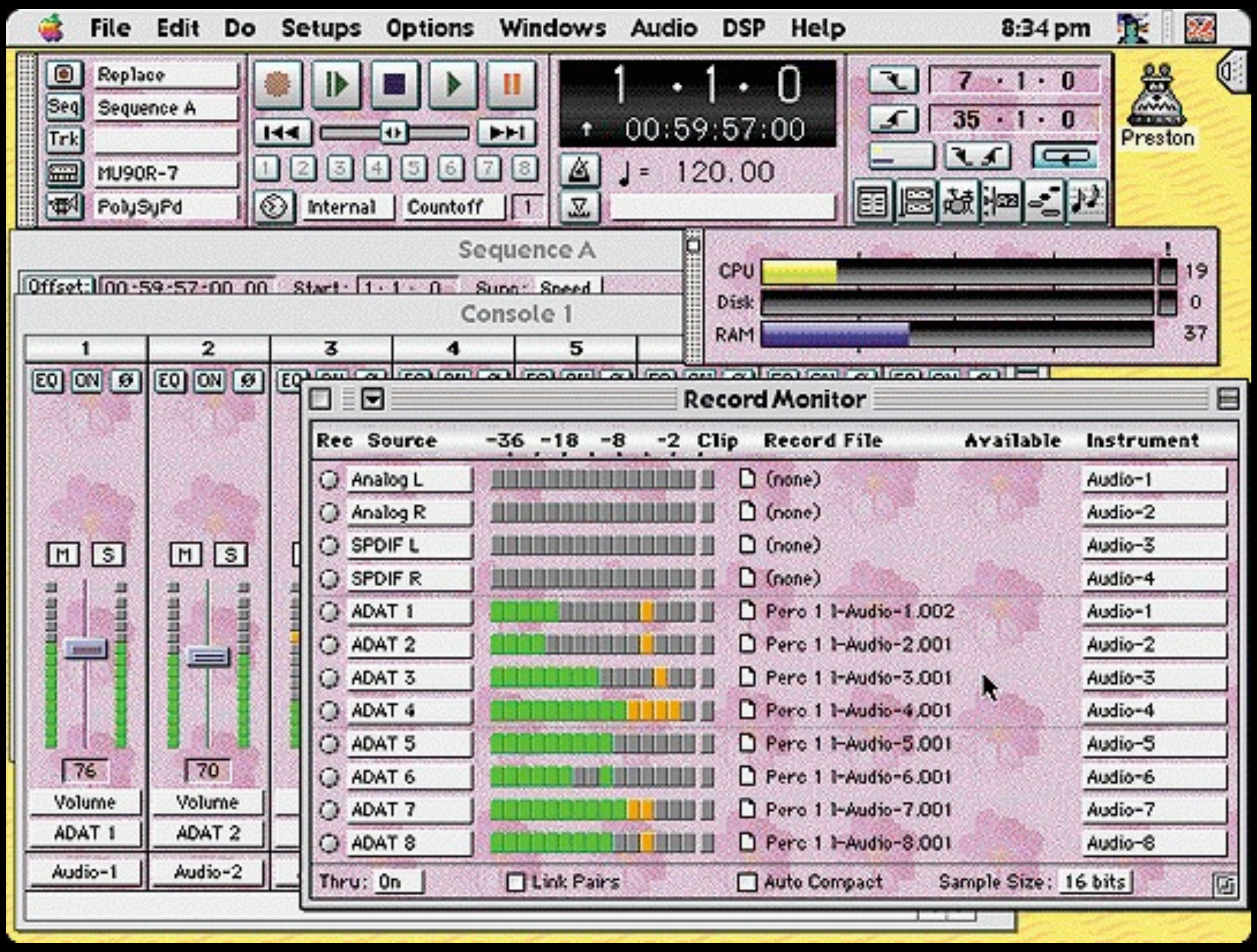
Because MIDI separated the sound from the performance gesture, sending messages over time that described performance actions, the first logical software would be one that recorded these messages. The relationship to the tape recorder is obvious; apart from the fact that the recording would not actually capture audio data, it was a model that had a clear history with and relationship to the musician.

Studio composition using the tape recorder and synthesizer offered only limited editing capabilities, particularly when it involved the relationships between layers or parts. For example, a composer might create an interesting low-frequency patch and record some rhythmic gestures on track one (i.e., a bass line) that lasted a minute or two. Then he or she might create a higher-frequency patch that could function as a foreground gesture (i.e., a melody) related to the first track. In order to coordinate the two layers so that a meaningful relationship occurred, the composer would play back the first track and record a live performance of the foreground gesture on the second track. This process is known as overdubbing.

Unfortunately, if the performance was in some way flawed, the only choice the composer had was to rerecord the second track; there was no editing possible other than recording only a small portion of the track again (a process called punching in). And punching in introduced new problems; for example, if the second track contained long sustained sounds, punching in would cut off a sustained sound when the record button was pressed.



But the MIDI tape recorder model eliminated many of these difficulties since the recorded information was discrete event data (note-on, note-off, pitch bend, etc.). Once these events were recorded, they were digital data like any other data on the computer, and they could be edited in ways similar to other computer data: precise editing, copying, moving, deleting, saving, recalling. Computers such as the Macintosh and Atari ST offered a graphic user interface for these processes, and early MIDI recorder/editors became the standard MIDI software.



In 1985, Opcode sold the first commercial MIDI software for the Macintosh under the nameSequencer. This name had a historical reference in the analogue sequencers first found on the Buchla synthesizer. These devices allowed the user to store predefined settings and recall them later through the use of a continuous pulse clock. The same basic principle is used in the digital version, andSequencer has continued to be applied to all MIDI event recorder/editor programs.

With MIDI sequencers, not only was the note event data editable but also all of the seven MIDI parameters (ranging from note-on/off, to aftertouch, modulation, pitch bend, program change, etc.) could be specified for a particular time event. So the MIDI sequencer can be thought of as a MIDI data processor:

Record MIDI performance information

Edit this information

Store this information for later recall

Play back this information at any tempo.

Since Sequencer first appeared in 1985, very little has changed, other than the introduction of better interfaces and integrated digital audio.

The Yamaha DX-7

Hey, what happened to all the knobs?

The Librarian/Editor

Another type of software that appeared in the mid-1980s was the MIDI patch editor. It was used to edit internal patches or sounds in a synthesizer and store them on the computer. As synthesizers became more complex in the early 1980s and began to incorporate digital technologies, it was no longer possible, or affordable, to represent every parameter with dials and knobs. Editing a sound on the Yamaha DX-7 (1983) was extremely complex because it was done on a tiny LCD screen. Even though every parameter of the sound was editable, only one parameter was displayed at a time. As a result, intuitive editing was impossible.

Playing a sound on a Prophet 5, for example, could involve real-time parameter changes of the filter. You made a change, and immediately heard its result. On the DX-7, you had to understand exactly how FM synthesis operated and what each parameter did in relation to the sound.

Because MIDI allowed for specific information to be sent to specific synthesizers (via system exclusive), patch editing became possible using MIDI and a software program.

Programs for editing the DX-7 appeared almost immediately. But as musicians continued to alter their setups with new equipment, these specific editors became dated. The next trend was the universal editor, in which a single program had modules to deal with different synthesizers. When a new synthesizer was released, a new editor module was also released.

Of more general use was the Patch Librarian. This program simply stored the internal settings of the synthesizer's parameters without allowing for any editing. Once these settings were in the computer, they could be combined with other settings to create libraries (e.g., all the different piano-like sounds, or all the bass sounds, or the slow-evolving sounds). When they were needed within a composition, these sounds could quickly be reloaded into the synthesizer to allow the composer to choose the best sound for the situation.

Controllers/Alternate Controllers: With the proliferation of MIDI, musicians had access to most of the instruments remotely without having to clutter up the stage; therefore, they did not need to have multiple keyboards. Thus, companies began to separate the controller from the synthesis section, marketing the two sections separately:

The synthesizer module, which made the sound but needed to be triggered via MIDI from either a master keyboard or a computer

The master keyboard, which made no sound but was optimized as a performance instrument with weighted, full-size keys like those of a piano.

The Buchla Thunder

The Buchla Thunder, a percussion controller.
The Thunder was designed as a percussion controller with touch-sensitive surfaces that could be played with the hands or with sticks. Each of the different areas, called zones, could be programmed to respond separately to strike velocity (how hard it was hit), location on the zone, and pressure (continued pressure after the initial strike, similar to aftertouch on a MIDI keyboard).

The Buchla Lightning

Another of Buchla's innovative designs was the Lightning, an instrument that sensed the position and movement of handheld wands. This information was then transformed to MIDI signals. Based on principles of optical triangulation, the Lightning gathered its information by tracking tiny infrared transmitters that were built into baton-like wands.

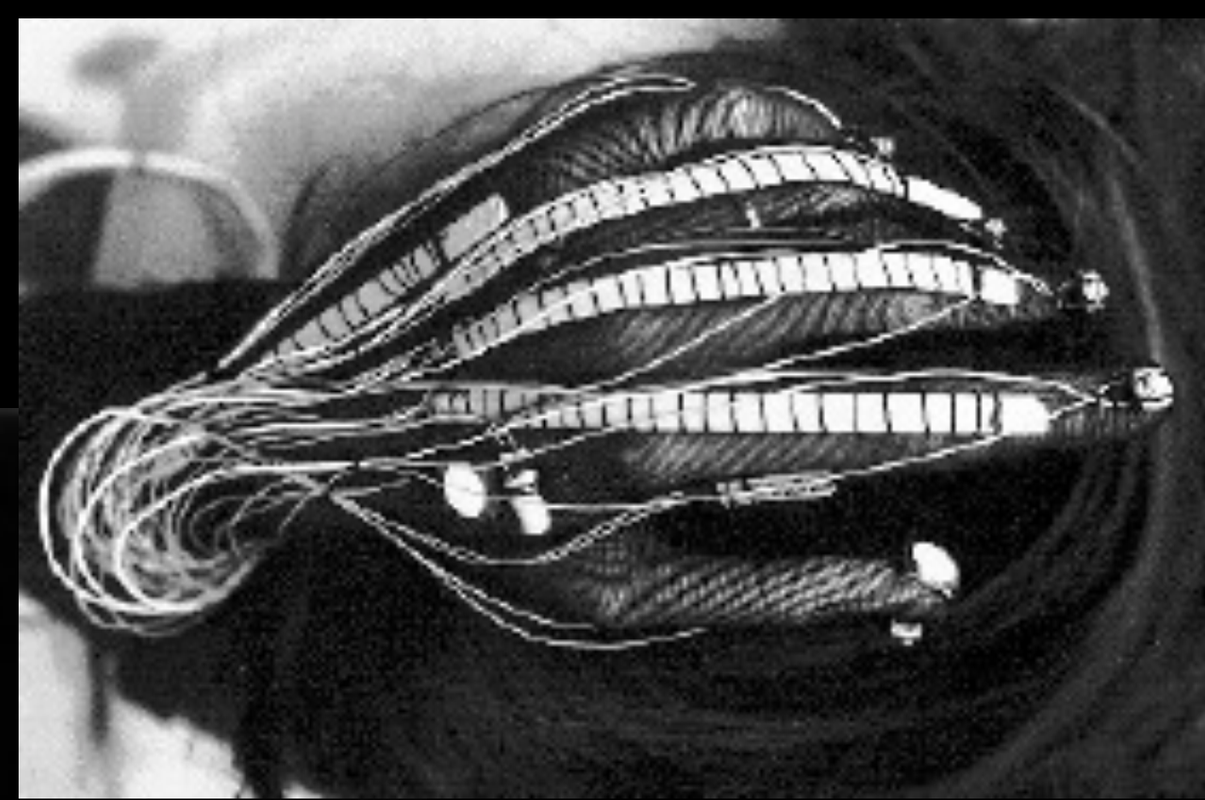
Basically, it sensed the horizontal and vertical position of each hand, for a total of four independent coordinates. From this information, the Lightning's digital signal processor computed instantaneous velocity and acceleration and performed detailed analysis of gesture. An interface language allowed the user to define relationships between various gestures and potential musical responses.

Max Mathews's Radio Baton

Max Mathews, the creator of the first computer music language, has continued to have a lasting impact upon electroacoustic music.

Max Mathews with his Radio Drum.
With the Radio Baton (also known as the Radio Drum), Mathews was trying to make it possible not only for sophisticated electroacoustic musicians to interact with electronic sources but also for non-musicians to play music.
Playing the Radio Drum involves moving two wands that look like drumsticks over a surface about the size of a breakfast tray. The wands contain low-frequency radio-signal transmitters, and the surface contains the receivers. The tray could be (electronically) configured into subsurfaces similar to the Buchla Thunder, and it could sense not only contact but also proximity and speed of the baton. Thus, it could be used like a conductor's baton, or as a drum.
Mathews felt that the most difficult part of learning to play an instrument was the control of pitch and harmony, while the control over rhythm was the most natural. His conception was that a non-musician could tap the Radio Drum and so trigger a computer to play complex music. Through simple changes in the speed of tapping, the performer could produce intricate musical results.
One work that exploits the drum possibility is "Wildlife" by Andrew Schloss and David Jaffe. A pitch played by the electric Zeta violin (with a pitch follower) would trigger a chord (since it was run through a Macintosh running an analysis program), but which chord and in which register would be determined by the positioning of the mallets on the Radio Baton.
Schloss:
We need controllers that refer to physical experience and, yes, I want to make a drum, but I want to be able to do things that you can't do with a physical drum. (Chadabe, p. 234-235)

Schloss's aim was to extend what could be done with a drum, particularly in modifying sounds. He differentiated, for example, between hitting the surface of the Radio Baton (whack mode) and moving a mallet continuously through space (continuous mode), and he used one



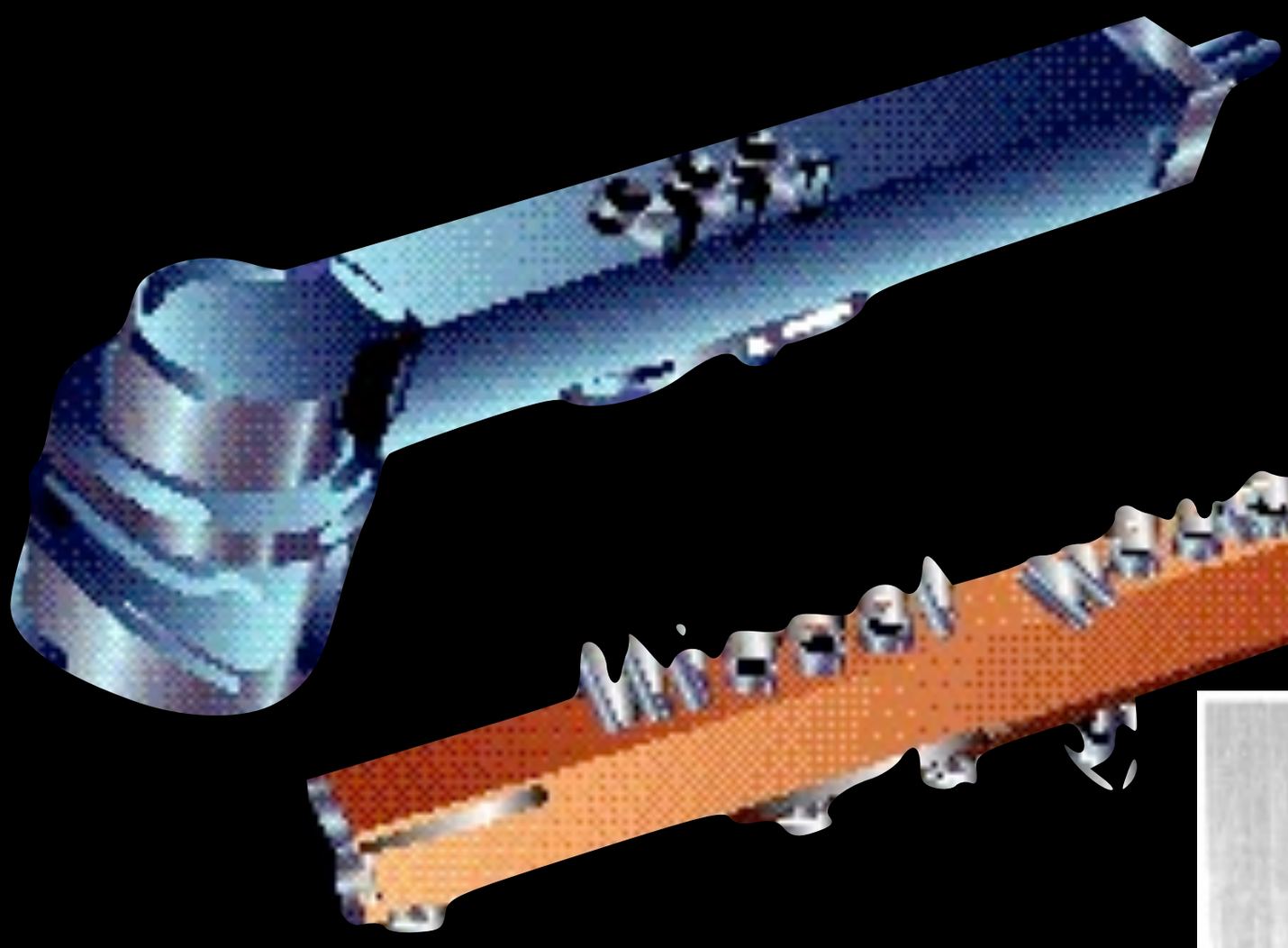
Laetitia Sonami's Lady's Glove

Laetitia Sonami's Lady's Glove

Laetitia Sonami is a performance artist who came out of the John Cage school of anti-art and the Happening. Her performance interface is a personal device intended for her own art. The Lady's Gloveis an arm's-length glove made of soft cloth, the fingertips containing micro-switches, which are the only visible controls. Flex sensors respond to bending the wrist and the three middle fingers. Each of the finger sensors reports two values, one for bending the lower finger joint and one for bending the upper one. Inside the fingertips, there are magnetic sensors. The magnets are in the opposing thumb so they respond to the distance of each fingertip from the thumb. There is a pressure pad between index finger and thumb so that the thumb can press against the inside of the index finger. There is also an ultrasound emitter in the palm with a receiver in the belt and in the shoe.

The complexity of the interface is masked by the simplicity of its use. Sonami's performances usually involve storytelling. While talking, she moves her arm—sometimes slowly and elegantly, at other times dramatically. Her gestures are sent to a computer that manipulates her spoken dialogue.

This is for me the ultimate instrument in dealing with expressivity in electronic music—if you move one finger, everything else moves. It's multiple controls to multiple variables in the sound.



The Electronic Valve Instrument [EVI] and the Electronic Woodwind Instrument (EWI) were commercial devices developed to allow wind instrumentalists to play MIDI modules. Unlike many of the other controllers, these were meant to control a synthesizer directly.
The EWI is played using saxophone technique, while the EVI uses a trumpet technique; like all MIDI controllers, they make no sounds on their own. Composer/performers such as Gary Lee Nelson used such instruments not as simple controllers to play brass (and/or saxophone) sounds but rather as more complex input devices into compositional systems.

The Hands = Amsterdam, Steim Institute – designed specifically for Michel Waisvisz (Steim's director at the time). The Hands (1984): One year after the MIDI standard had been introduced, Waisvisz built the first experimental interface making use of sensor data converted into MIDI. The two wooden frames attached to both hands let him play music with hand and arm movements, tilting gestures, and fingered playing. Converting analog sensor data into digital musical data has become a major issue at STEIM in the 1990s, introducing the mini computer The SensorLab.

MIDI Today

As computers have become faster and faster, external sound modules have been required less and less. For example, software synthesizers and samplers, such as Native Intstruments' Kontakt, Reaktor, and Absynth, Steinberg's HALion (to name a few of the more popular ones) are now standard within today's computer systems. MIDI's main task was to connect the computer/controller to sound modules, and so MIDI is being used less and less in this manner.

Is DJing Electroacoustic Performance?

In recent years, a new avenue of live electroacoustic performance instruments has appeared in response to the growing popularity of DJ-ing.

Traditionally, DJ-ing refers to the playing of prerecorded discs (formerly records, now CDs) of music. It gained popularity in North America during the 1970s and early 1980s in response to the high cost of hiring live musicians. People with absolutely no musical training, or even musicality, could be hired as DJs to play music for people to dance to.

Arguably, the Jamaican Dub movement was a precursor of modern DJ-ing. It began in the 1950s as a dancehall replacement for the expensive Kingston orchestras and consisted of an MC, a selector (DJ) with a turntable, an amplifier, and enormous speakers, called Houses of Joy. The Jamaican DJs would not only play obscure American R&B but also original instrumental versions of the same tracks. There would be spaces in the music, which allowed for the DJ to interject, exhort the crowd to dance, or generally comment on the record.

This participatory style of DJing migrated to New York in the 1970s, and eventually to a Chicago dance club called the Warehouse. The music played at the 'House was essentially disco (as in Donna Summers), with an added drum machine. People interested in the music went to record stores looking for the new House style.

Competition among DJs involved mixing tricks (EQ) and adding sound effects as well as "scratching" into their sets. This led to the creation of tracks, which were little more than drum tracks with bass parts, over which the DJs would add these effects and additional elements.

live performance issues

are the gestures of the live performer related to the music in some way?
what is the relationship of gesture to sound?
what about expression?
what about virtuosity of the performer?
what about transparency?
etc., etc.,