

**MAX NEUHAUS**

# The **BROADCAST WORKS** and **AUDIUM**

**MAX NEUHAUS: SOUND DESIGN**

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I would like to begin by talking about something I feel is quite astonishing - this built-in sound analyzer and source that we all have. One of the most astonishing things about it is that we are largely unaware of it.



Right now I'm talking to all of you, but few of you realize you're actually hearing. You don't hear what I'm saying as sound; you are able to understand this small group of phoneme sounds directly as the English language. Your aural mind takes care of all the intricate steps in

between, without distracting you from thinking about the meaning of the words.

I am also fascinated by the remarkable level of aural discrimination which we demonstrate through our use of language. If we look at our language sounds in the context of the total spectrum of sound possibilities that we are able to perceive, then we can see that these sounds that we communicate ideas and thoughts with

occupy only a minute part of that spectrum, and that the differences between them are very small, so small that a non-native speaker has trouble distinguishing between many of them. Yet in our own language we go much further than simply distinguishing between its phoneme sounds. We can tell which part of the country someone was born in from small differences in the way these few sounds are pronounced. These differences are almost immeasurable, yet we are able to distinguish them quite easily, almost automatically.

Another thing most of us are not aware of when we speak is that we superimpose another language on top of our verbal one. It is a language we begin to develop at a very early age - that some say we are even born with. It is cross-cultural.

It is not a discrete language made up of separate words like our verbal one, but a continuum of inflection and intonation as we speak those words. It is a rich source of information about the person we are listening to and what he is trying to tell us - the information between the lines, the missing element which we try to compensate for when we transcribe the spoken into the written word.

It is a parallel to facial expression; we read tone of voice without thinking, as well. It also provides highly accurate information: it is hard for the speaker to manipulate convincingly. Often we use it as the final arbiter of the meaning of the words themselves.

This language has not received much attention from scientists and engineers. In fact, for many years telephone engineers denied its existence both theoretically and literally by limiting telephone bandwidth to the point where it was largely eliminated and only the words themselves could be understood. Modern proposals where the voice sounds in a telephone conversation would not actually be transmitted, but only enough information to

resynthesize the words at the other end, deny its existence also.

seems strange for science to ignore it, especially in the digital age when they are trying to get computers to feel more comfortable by teaching them to talk; it is also the element missing from computer speech. But, among other things, intonation communicates the emotional states of the person speaking; and in the super objective world of science, of course, emotion is taboo.

In the world of culture, though, it is not.

I should also give some background about the ways I think about broadcasting and telephony. Radio and telephone both may seem like rather primitive technologies in this digital age at the end of the twentieth century, but in fact they are the most widely used forms of live communication technologies we have and will remain so for a long time to come.

The global telephone system at this time connects 500 million different places on the earth. It is the biggest machine that we have ever made. This idea of a conversation between two people that can ignore geography: the quality of the line is good enough today that often when I call transatlantic I can convince the other person I'm in New York even though I'm sitting in Paris. The only time I'm caught is when a police car goes by, and they hear the difference in sirens ... Max, you are not ... where are you?

The telephone forms a two-way virtual space in the aural dimension; we function in it aurally as if we were in one real space, but this space doesn't physically exist. The radio on the other hand can give us a live ear view into a space which can be anywhere or nowhere; it can also be completely electronic.

The fact that these are single dimension virtual spaces has some interesting aspects. Rather than the multidimensional virtual realities we are dreaming of in the future, which many look forward to as even better than real life, and some fear will become a substitute for it, a one dimensional virtual space doesn't engulf us. It leaves us in our real world, but extends it. In the same way that the radio is less engulfing than the television, an aural virtual space repropotions focus and stimulates imagination rather than becoming a substitute for it. If we combine the public telephone network and radio broadcast, we can make a virtual aural space in which a large number of people can be at the same time.

This is what I did with "Public Supply I".

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## **THE BROADCAST WORKS: PUBLIC SUPPLY**

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Looking back to 1966, it seems as though I began these broadcast pieces almost by accident. I was asked by a woman who was the music director at radio station WBAI in New York if she could interview me. At a certain moment while thinking about it I had this idea - instead of talking, why not try to make a work for the radio itself?

I was a performer at that time, but I was interested in trying to move beyond that and beyond being a composer, into the idea of being a catalyser of sound activity.

I realized I could open a large door into the radio studio with the telephone; if I installed telephone lines in the studio, anybody could sonically walk in from any telephone. At that time there were no live call-in shows. The idea of putting phone calls directly on the air rather than prerecording them was not greeted with open arms. The engineer insisted the station would lose its license and refused to have anything to do with it; his solution was to put a mike in the studio and pretend it was a strange kind of interview show.

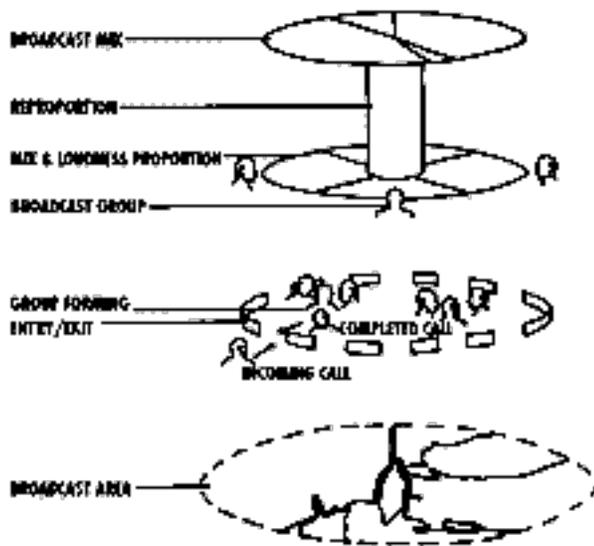
I got the telephone company to install ten telephones in the studio by telling them they were for taking the responses for a fund-raising campaign. The engineer laughed and asked me how I was going to answer them all. I also had to find a way to get them on the air; he would only give me an hour of studio time just before the broadcast.

With a friend, I built this wonderful pre-answering-machine ten-line answering machine. Each phone sat on a small platform and had a solenoid-controlled lever which fit under its receiver. A plastic cup with a microphone inside was fitted

over the ear piece. The mikes and solenoids were connected to a box with switches controlling the solenoids, and with pots for the mike gains. The output went to an amp and a speaker. The studio engineer looked in a few minutes before air time expecting hopeless chaos. It was a bit strange but not chaos - ten telephones on the floor with their handsets popping up and down and voices coming out of a speaker in front of his microphone. There wasn't much he could do; he flipped the switch and put us on the air.

The results were wonderfully unexpected. I had done a mailing which told people about the time and phone number, so there was no shortage of calls. In fact, because there were so many, entering into the work became a game of chance. To get in, your call had to coincide with that of another person just hanging up.

I had told people they could phone in any sounds they wanted and asked them to leave their radio on while calling so that I would have some different feedbacks to work with. I saw myself as a sort of moderator; I tried to form interesting combinations of callers on the air and counterbalance the extroverted with the introverted.



NEUHAUS BROADCAST WORK 1988, WBAI, NEW YORK CITY

I think I was a little in shock after it was over. It wasn't an idea that I had constructed; it just came to me, whole. I realized the scale of this thing. On the screen the map at the bottom of the drawing shows Manhattan Island; to the right we have

Brooklyn, Queens and above the Bronx. I had made a virtual space which any one of the ten million people living there could enter into by dialing a telephone number. It gave me a

lot to think about.

I realize now that the reason I did it had to do with some of my ideas about music.

We don't know much about the history of the sound activities in societies of the past. We have some of the artifacts but none of the sounds; we only have recordings of the last sixty years. Our histories talk about other things; we have writings and drawings that go back thousands of years.

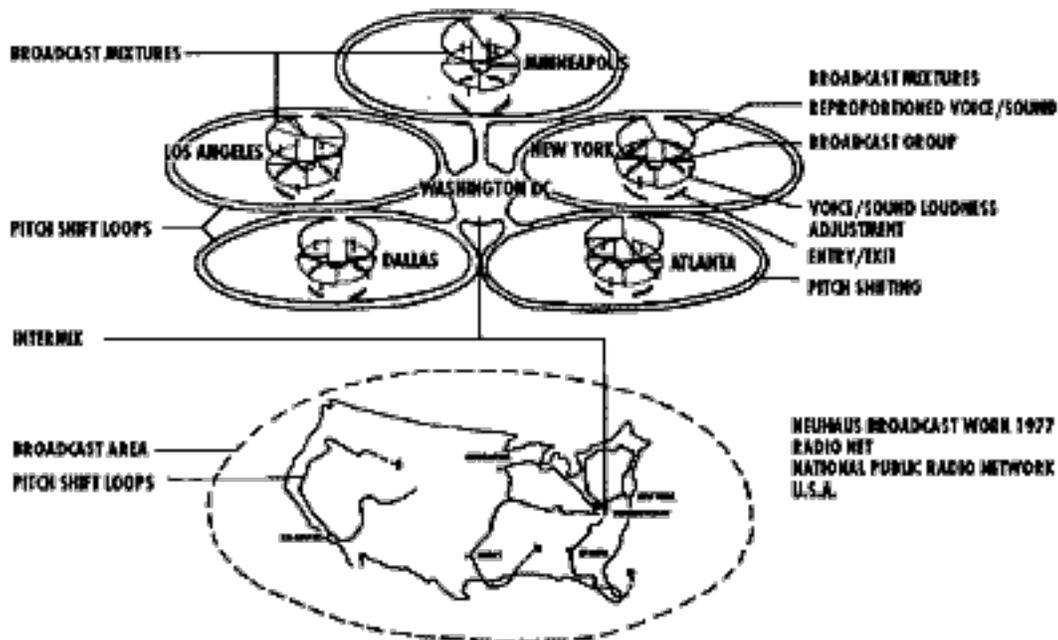
Therefore we don't know very much about the music of the past either; what it really sounded like, who played it, and its role in society are all debatable questions when we step back only a short time in history.

Anthropologists in looking at societies which have not yet had contact with modern man have often found whole communities making music together - not one small group making music for the others to listen to, but music as a sound dialogue among all the members of the community.

Although I was not able to articulate it in 1966, now, after having worked with this idea for a long time and talked about it and thought about it, it seems that what these works are really about is proposing to reinstate a kind of music which we have forgotten about and which is perhaps the original impulse for music in man: not making a musical product to be listened to, but forming a dialogue, a dialogue without language, a sound dialogue.

These pieces then are about building the circumstances where ordinary people can begin this nonverbal dialogue. We all have highly developed skills in hearing and vocalization - these innate skills demonstrated by our ability with language. The telephone and radio themselves provide a good foundation as they focus the mind on sound and their visual anonymity helps overcome selfconsciousness. The real problem then is finding ways to escape from our present conceptions of what music is.

The first thing I realized after "Public Supply I" was that with a conventional hand mixer it was impossible to control ten lines at the same time. I felt I had to find a way to use the skill that I had in my hands from being a musician to make it a more fluid situation. I built what I called a finger mixer; it was a flat plate with four photocells for each finger arranged in the shape of my hand. Each caller was assigned two of these photocells with which I could control his gain and stereo position; this meant that just by moving my hand very slightly and letting more or less light fall on different photocells I could shape gain and position of all ten callers simultaneously. I had a very fine control, and it allowed me to move the mixing and grouping into something which was fast-moving and dynamic. I first used it in Toronto in 1968.



By 1973 in Chicago at WFMT there was no guerrilla warfare anymore; after seven years they were beginning to get the idea. Here I started exploring the concept of giving people special instruments to play with their voice over the telephone. In this work I built a synthesis circuit for each

caller. Rather simple: oscillators where the pitch was determined by the energy of each call. The signals were integrated over a long period of time, so that the result was a bank of slowly shifting pitches forming a cluster which was constantly reforming according to what people were doing. The sounds that they were making rode along on top of this.

In that same year I proposed to National Public Radio that we try to do not just one station but their whole network of two hundred stations spread across the country with five cities where people could call: New York, Dallas, Atlanta, Minneapolis and Los Angeles.

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## **THE BROADCAST WORKS: RADIO NET**

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Having made this vocally played instrument for Chicago led me to think about having the callers also do the mixing and grouping for themselves. Obviously I could not be in these five places mixing and grouping at once; so I decided to remove myself completely from that process and implement it as an autonomous electronic system.

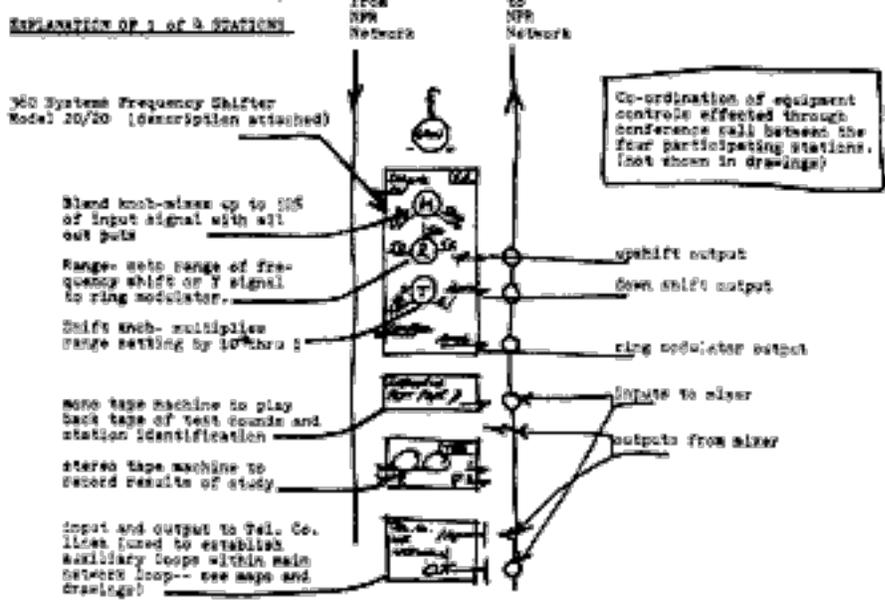
In 'Radio Net', the mixing was done with what could be seen as a special case of time-division multiplexing. Although heard as a conventional mix of input signals, the output was actually being switched very quickly from input to input. The perceived level of an input in the mix depended on how long the output lingered on it. The technique allowed automatic mixing according to an analysis of each signal; the criterion I used here was that the highest pitched signal at any given instant won the output for that particular fraction of a second.

A week before the broadcast, I shipped these self-mixers to the engineers at the stations in each of the call-in cities and hooked up and debugged them over the phone.

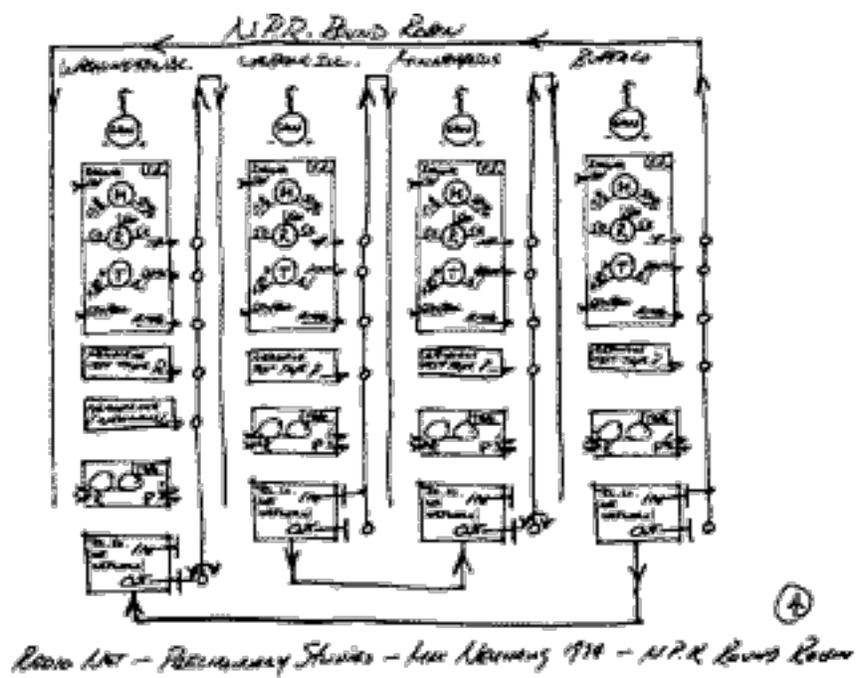
In those days radio programs on NPR were distributed by what they called a Round Robin - telephone lines connecting all two hundred stations into a large loop stretching across the country. Any station in the system could broadcast a program on all the others by opening the loop and feeding the program around it.

I saw that it was possible to make the loop itself into a sound-transformation circuit and tried a few things with it in several preliminary studies in 1974

*Radio Net - Preliminary Studies - © Line November 1974*



For the broadcast I decided to configure it into five loops, one for each call-in city, all entering and leaving the NPR studios in Washington. Instead of being open loops as usual during a broadcast, though, I wanted to close them and insert a frequency shifter in each so that the sounds would circulate; it created a sound-transformation 'box' that was literally fifteen hundred miles wide by three thousand miles long with five ins and five outs emerging in Washington



We had a "dress rehearsal" the day before the broadcast so I could get a feel for things. It is touchy when you put a wire that long in a loop; even if you do have a frequency shifter and gain control, each loop was in a sense a living thing - they could get out of hand very quickly. During the broadcast I was on a conference call with the five engineers and could listen to each loop and ask them for changes in shift and gain at any time. My role was holding the balance of this big five-looped animal with as little movement as possible.



*Radio Net - Interconnecting Services © 1991 NEUMANUS-1974 - NPR Round Table* 

In all the previous works I had left the nature of the sounds phoned in for each caller to decide. Here I wanted to provide an indication to try and move them past the "Listen, it's my voice on the radio" stage and towards listening to one another. The question was what kind of indication - how does one indicate something to perhaps half a million people with their diverse backgrounds, intentions, and ways of interpreting? I decided to ask them simply to whistle.

The results of asking half a million people to do anything, even something as simple as whistling, of course will be diverse. Some will do it; others won't. Those who do will

choose how or what to whistle. Even though it may seem a very specific request, for me it was a broad indicator to provide a body of pitched material in the work.



During the broadcast, the sounds phoned into each city passed through its self-mixer and started looping. With each cross-country pass, each sound made another layer, overlapping itself at different pitches until it gradually died away. It was quite a beautiful Sunday afternoon - two hours over which ten thousand people found their way into the work and made sounds.

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**MAX NEUHAUS**

## **AUDIUM**

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Radio Net was done in 1977, and shortly after finishing it I began to develop an international project which I called "Audium". I was interested in including people with different native tongues in this nonverbal dialogue. I also wanted to go further in removing myself from the actual process of the broadcasts - this idea of implementing these virtual spaces in a completely autonomous system. There were also some other new ideas which I will come to.

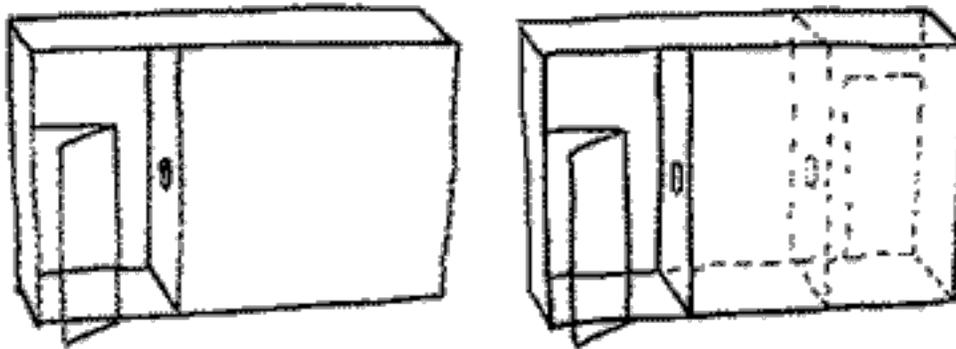
I think of an electronic system as a special kind of statement of idea. Writing something in words on a piece of paper or making a drawing are static statements of idea. If you program an idea into a computer system, though, you not only have the written statement of the idea but the system also realizes the idea - dynamic statement of idea. I wanted to implement "Audium" in a system which would not only state the idea but execute it as well.

All the previous systems had been built with analog circuitry because that was the only technology available. Here, I wanted the freedom of moving into the digital world. Unfortunately in 1980 the digital sound world was not there. I did find a very strange company in Massachusetts who made a digital signal-processing box that weighed a couple of hundred pounds; they were very curious who I was because their only other customer was the US Navy. Theoretically one could have done something with it; but it would have been starting from scratch, a decade of writing assembly-code routines. So throughout the eighties I concentrated on other things.

In the beginning of the nineties I noticed that the means to realize many of my digital dreams were sitting in boxes in

the music store as sound-processing and synthesis devices. There were also some computer languages around to control them in ways beyond what their manufacturers intended and envisaged. In 1990 I began collecting research material for a work called "Audium Model".

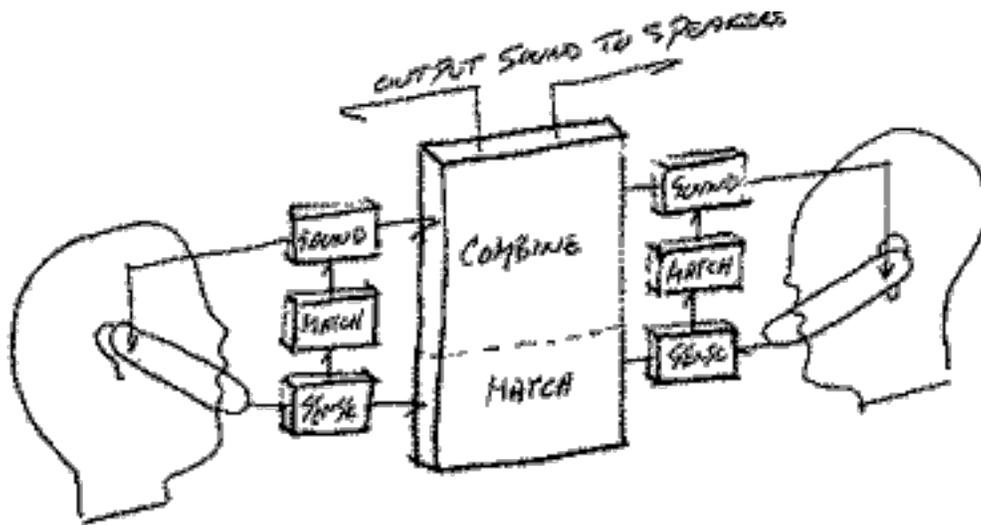
The most difficult thing about realizing large new ideas is explaining what they are to those who will provide the support to realize them. You can talk about it and write about it, but if it is a genuinely new idea there are by definition no references. You are asking them to imagine what you are imagining by hinting at it in a foreign tongue.



In addition to being a work in its own right, "Audium Model" is also the first step in the aesthetic research for "Audium" and a realization of its fundamental concepts. It consists of a special double phone booth for two people: two rooms, each with one transparent wall with a door in it. Inside each room is a telephone handset mounted on the wall. To model the conditions of a phone call, the booths are arranged so that the occupants can't see each other.

The handsets connect them through a third party - the computer system which comprises the work. The aural result of the sound activities between these three parties emanates from speakers outside the booths.

So we have the elements of "Audium": the telephone hand-sets represent any telephone, the electronic system is the moderator, and the speakers outside the booths are the broadcast.



The electronic system has two roles. One, it engages in a sound dialogue with each of the occupants of the booths and, two, it acts as the instrument which they play on with their voices. This general form of the work has been fixed. I am now in the process of research which will define the rest of it. The block diagram shows the current state of my ideas about the flows of information and sound.

You can see that there is an arrow going back from the work into the ear piece of each person's telephone. This is a new idea for the broadcast works - what I am calling an active score - a dialogue between each person and the work.

When we speak we have to listen constantly to the sound we are making and adjust our sound-producing muscles so that it matches the phoneme we are trying to pronounce. If we could not hear ourselves, we could no longer speak accurately; we need this constant feedback even though we have been doing it all our lives. I want to add another layer to this feedback.

In spite of science's general aversion to studying the language of inflection, there have been a number researchers who have been interested in the question over the last fifty years. Most have been motivated by a quest to quantify emotion, many with the goals of lie detection and business advantage. As a result of all this, the basic acoustic parameters of intonation have emerged. Quantifying their

meaning is another question, but of course that is not what I am interested in doing here.

The dialogue between the work and the persons in the booths will be in the language of inflection. The work will 'recognize' a person's vocal phrases by inflection and continually respond by generating sound for his ear piece - a special sound feed-back which is built for each person as he vocalizes. I hope it will be a means of breaking away from the stereotyped ideas of what music is and can guide them out of their self-consciousness and past their preconceptions.

The acoustic parameters of inflection are of course patterns of fundamental frequency, amplitude, formant and spectrum. So far I have built and am working with a system which can extract some of these parameters in real time from two people simultaneously. I have also implemented a neural network algorithm which allows one-pass categorization and mapping of analog vectors also in real time.<sup>1</sup> It can be used to generalize - to make decisions through inference and extrapolation - and it learns immediately. It is not like a back propagation neural net which has to be taught for a few hours; it only takes this one ten milliseconds to find or learn a category.

These are the components I will use to build the work's sense of each person's vocal activity and its sound response for the active scores.

The other part of the work, again an instrument that can be played by the voice, will generate the work's output sound. It will also use this sense of the person's vocal activity to adjust itself while being played. Currently I am experimenting with some imaginary string spaces - digital implementations of six separate strings whose characteristics can be modulated in real time. Because I have all this information about frequency and amplitude coming in, I can not only apply a voice-sound to activate the string; but I can also get the string to listen and respond to what it is being touched with. I like the idea of being able to pluck or stroke

a listening string with your tongue from a distance of 10,000 miles over a telephone.

Of course the realization of one "Audium Model" does not model the multilingual nature of "Audium". After the first realization the next step would be to implement several 'Audium Models' in different language groups and interconnect them; this is fairly straight forward once the first "Audium Model" is made. This network of interconnected "Audium Models", as an international installation, is the real model of 'Audium' itself.

An additional idea for these broadcast works which I became convinced of after "Radio Net" and I hope will be implemented with 'Audium' is the one of a radio installation. All of the works so far have been radio events, because that is the nature of radio in most people's minds: it has events - radio shows. But one could also make a radio installation.

Although a radio event certainly gets attention and encourages people to enter into it, at the same time it makes it difficult to do so as it generates congestion. In "Radio Net", 10,000 won and got their calls through. This probably means that 100,000 tried and weren't successful. There is no way to install enough lines to respond to a call-in request of this kind over the radio; the more lines you add the more people are encouraged to call in. The radio event also discourages the development of a group dialogue; everyone knows they have only a certain amount of time and wants to get their say in.

But if it's always there you can call in at any time, and you can stay in as long as you want; it allows a natural long term evolution of this new kind of sound dialogue. It becomes an entity - a virtual place.

Do I sense shivers of panic running up the spine of radio administration?

Of course it is very expensive to run a radio station, and to

dedicate it to one idea is unheard of.

Or is it?

In fact many radio stations are dedicated to one idea - rock, news, sports, etc. "Audium" is another idea of programming; and one hopes its live and unpredictable nature, its continuous evolution, and its international character will combine to make it quite a bit more interesting than many others.

I hear them whispering "But the band is so crowded; there aren't enough frequencies to allow another station for such a strange idea".

Right now the AM band and many of its transmitters are being abandoned - deserted for the world of FM. "Audium" could live quite happily in all that empty territory, emanating from a few of those unwanted transmitters.

It would be considerably less expensive than other forms of programming. The major cost of a radio station is not the broadcasting equipment, nor the electricity to run it. It is the making of radio shows.

"Audium" doesn't require staff; it is simply an electronic system with one side connected to the phone network and the other to the transmitter. 'Audium' programs itself, or more accurately it is programmed by the people who will use it.

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