SPECIAL SECTION

Harnessing Waves and Elastic Space

Liz Phillips

ABSTRACT

The author describes examples of her sculptural and installation works, which involve acoustics, electronics, visual elements and elements from natural environments. She also provides a background of historical works and influences.

As an artist, I use open systems to collaborate with audiences and to interact with the natural environment. Sound in my work functions as a material (like steel or wood or clay) and is both signal and music as it describes activity in space. I began as a sculptor and migrated into music as electronic music opened up to include natural and electronic sound and space. Sensing and harvesting sonic material allows for dynamic transformations in composition. Stillness and location, absence and presence, activity and nearness can be abstracted from the material world. The creation of an intimate space and place for audience engagement (most often in galleries and public spaces) provides one of the only ways for the art audience to actively participate in abstraction. My sound installation art is grounded in a consciousness of space, listening to architecture and an attention to the historical significance of each site.

Acoustic Structures and Sound Technologies

The floors in the opening rooms in Ninomaru, a Japanese imperial palace, are called the "nightingale floors." Ninomaru was built in 1603 in Nijo Castle in Kyoto and designed for surveillance through the use of bird-call mimicry. When I walked along the tuned planks, the floors sang as they once did to protect the castle's original occupants [1]. Many large-scale ancient architectural projects were built with specific acoustics made to respond to human interaction. Churches with high barrel-vaulted ceilings enhance the speaker's voice, cause it to reverberate and sound more "holy." There is a long history of people harnessing natural energy to enrich their environments. The early Greeks designed the Aeolian harp, which is played when wind passes over its taut strings.

I responded to these older human-made acoustic structures. (I studied with the instrument-maker Gunnar Schoenbeck.) As I began creating my own sound sculpture, I also embraced new technologies whose development I became involved in and that are crucial to my work. Early radio technology facilitated the creation by the Russian inventor Léon Theremin in 1919 of the theremin: one of the first known musical instruments to respond to a person's movement in open space without physical

Liz Phillips (artist), 39-39 45th Street, Sunnyside, NY 11104, U.S.A. E-mail: <ofsound@earthlink.net>.

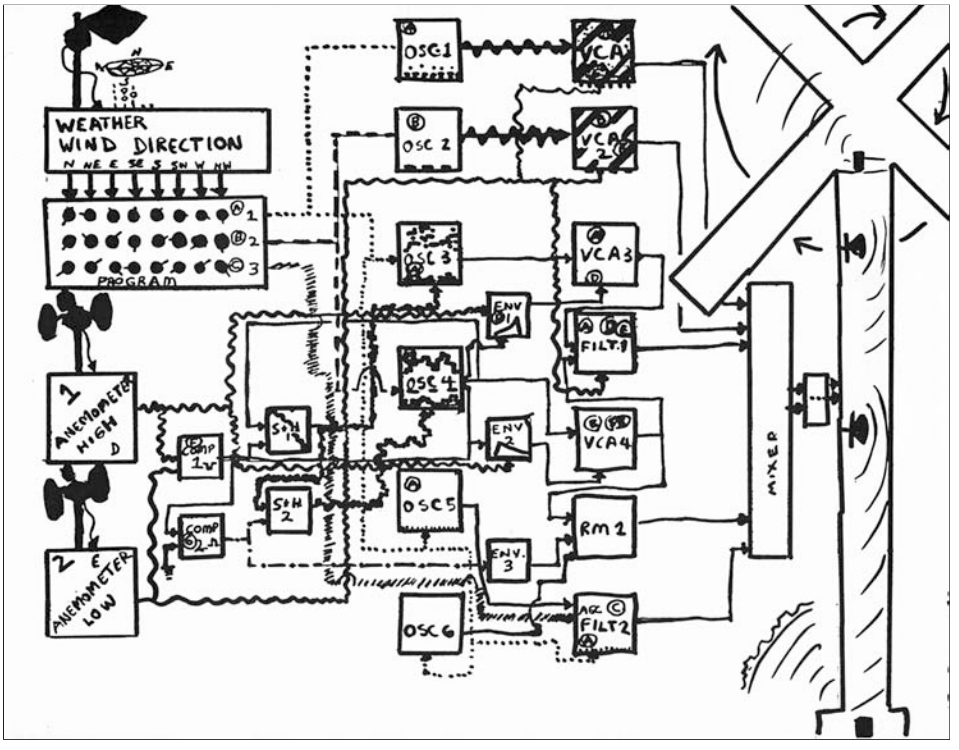

Fig 1. ***Windspun.*** **(Photo © Liz Phillips) This was my working Input-Output Chart for the Hunts Point installation of Windspun.**

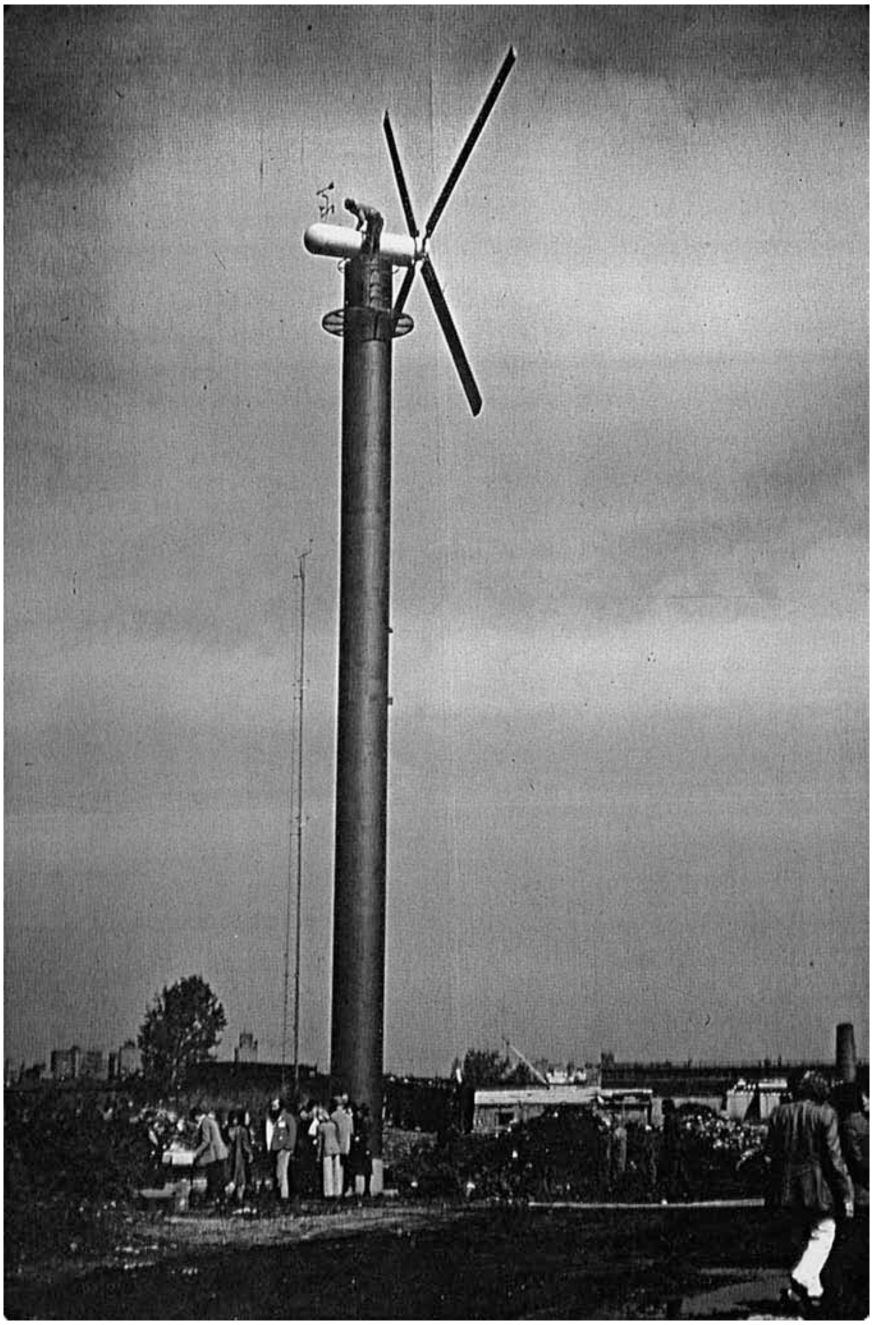

Fig. 2. *Windspun.* (Photo © Mary Lucier) Opening event for Windspun at The Bronx Frontier Development Corporation. The art opening was sponsored by Creative Time at the Hunts Point alternative energy and composting site in 1981.

contact [2]. Built with radio-frequency oscillators, it responds to the distance between one's hand and each antenna with shifts in the pitch and amplitude of an oscillator. The theremin plays a single voice in response to immediate motion. Analog sensing and synthesis made it possible for me to create installations in which changes in light or motion could be detected and played back as sound, light and video. Sound could fill a space and create an immersive tuned environment, whereas light could only be cast on surfaces and/or seen in video on monitors. Analog sensing and synthesis made it possible to create sound installations that were continuously changing. With interactive sound, works traverse immediate performance and deal with present, past and altered time. With new electronic memory and digital control, information and sounds change in inverse and proportional relationships and are delayed and accumulated. Through sound synthesis, the amplitude, pitch, timbre, modulations and durations of sound events can be activated and manipulated. An evolving time- and space-specific artwork takes place without the presence of the artist in a gallery or public space setting.

Sound Art Influences

Sound art did not develop independently; as a new art form it involved collaborative work with other people working in other media. The video artist Nam June Paik, for example, was a mentor and colleague with whom I often shared ideas. He studied music in Japan and electronic music in Germany before he created his first video art. In *Magnet TV* (1965), the image on a TV is "pulled" into shape by a large magnet above the TV. The electromagnetic fields create abstractions. After this work, he created the Paik/Abe Video Synthesizer (1969) to gain more control of color and shape through electronic color processing and synthesis. Although this work was in another medium, its use of electronics to artistically shape output was highly influential in my work.

One of the first stirring interactive sound sculptures was Jean Dupuy's *Heart Beats Dust* (1967). I saw it at the Museum of Modern Art's 1968 exhibition The Machine as Seen at the End of the Mechanical Age. A cone of light shines into the box. Different exhibitions use a tape of heartbeats, and/or the visitor's pulse as taken from a touch sensor. Amplified heartbeats elevate red dust (Lithol Rubine, a pigment able to remain suspended in air for long periods). Human physicality becomes interactive when essential body rhythms activate space. Interactive sound art has a unique ability to engage physical conditions such as the beating heart [3].

In my 1970 work *Sound Structures,* I was interested in how space becomes tangible for the audience. The theremin makes audible the distance between hands and antenna through sound; Jean Dupuy's piece uses the sound of the human heart to fill space with dust. In *Sound Structures,* a radio frequency capacitance field is radiated from a rectangle of metal under a rug. Sound is picked up on AM radios throughout the room. The sound changes because one's body conducts, grounding the field. There is no sound until someone enters the threshold area at the outer edge of the field. As a person moves toward the center, the frequency of the sound emitted by the radios goes higher and heterodynes through the radios. People can experience the conductivity of their bodies in the space. As they form chains (and touch things and each other), the surface area that their collective bodies are covering becomes larger. The conductivity to ground is stronger. They hear these changes as changes in pitch. The frequency ranges become exponentially closer as the number of

Fig. 3. ***Wavetable*****, metal table, transducer, water, amplifier, oscillators and aluminum bowl, 44 × 42 × 14 in, 2002. (Photo © CJ Cartiglia) The first Wavetable in my backyard in Sunnyside, NY.**

people increases. Each space conducts differently. The sub-audio edge of the field is felt at a different distance based on the room's conductivity, humidity and the temperature. People gather in groups to shift the "sound walls" because of their collective energy.

After *Sound Structures* I continued to make some of the first open systems in galleries, which asked audiences to work collectively to hear their parameters. I wanted to make work that could be shifted, with the potential for growth and dynamic transformation over time, and involved the audience in the process of sculpting space. In these later analog installations, an electrical charge is stored based on the directions of people's movement. As a visitor moves toward a sensor, if the voltage gets higher this fills (charges) a large capacitor (with a diode). It releases in its own time, or a switch samples and holds that voltage and thus that tuning. People cause a sound to move in real time as they walk toward an object. The sound remains when they leave and fades slowly away. Speed and direction of movement control how sounds come and go from silence. People standing still build up sounds with their presence. The integrating and proportioning of stored potential energy based on activity in time and space is a key element. Many layers of sound work together, responding in different ways to presence and absence, stillness and activity in threshold spaces. Sometimes I want people to feel as if they had gone for a walk in the woods and stepped on many plants, or damaged a garden, or grabbed something and taken it away with them, upon entering a space close to a sensor/object. Everyone plays a part in the resultant sound patterns left behind.

Sound Sculptures and Soundscapes

I define elastic space as the experience of audience members when they gesture, traverse across or stand still in space to shape sound events: They can stretch and manipulate and store potential energy or digital material so that their current movement takes on an altered significance that manifests itself through sound events in multiple time periods. During my first 4 years of making sound sculptures, I was dealing with the human figure in relationship to a room as an instrument using synthesized sound. Then I was commissioned to make a piece for the opening year of Artpark, in Lewiston, NY, near Niagara Falls, one of the first parks made for showing outdoor temporary artworks. Instead of electronic sound, I decided to use the sound of the river and record the river at different stages from the bank before and after the waterfall. I used the movement of the audience down a pathway in the park to carve (filter) through the sound that was set in multiple speakers along the pathway. My participation in Artpark gave me a chance to use natural sound. After that I began to explore the more active, cyclical parts of nature, such as wind, fish and water. In these works, I use similar processing and control systems but collect different material, timings, tunings and proportions.

My wind-activated sound installation *Windspun for Minneapolis* (1980) (Fig. 1) uses electronics as a tool to continuously carve a soundscape from the surroundings in which the work is heard. *Windspun* was formed with lower-power microcircuits. It responds to its environment by sensing wind speed and direction and the presence of each person in the installation space. Atmospheric kinetics create wind patterns that in turn are changed into sound patterns. An erector-set construction that stands in the pool supports the weathervane and two anemometers. It carries circuits and also supports a bronze screen embedded in clear Plexiglas. This screen radiates radio frequency capacitance fields that sense the presence, speed and direction of people walking on stepping stones. The audience/participants listen and manipulate details of the wind/sound construct.

Wind-Activated Sound Pieces

Extraordinary weather conditions aided *Windspun for Minneapolis,* my first wind-activated sound piece. The New Music America Festival 1980 coincided with a tornado watch, so the wind was active and would rapidly change direction. Each anemometer causes sounds to strengthen and fade, up and down. When the wind starts it sounds like breathing. Faster winds become rhythms. The fastest create drones. Each anemometer functions as a small windmill, generating more energy as the wind blows at higher velocities. One anemometer is on the water. The other is placed higher, with the weathervane, to pick up more general wind. The eight directions of the wind are picked up by the weathervane and shift the pitched tunings of the two drones. The drones tell the direction and speed of the wind. A trigger is caused by comparing the changing voltages of the two anemometers, creating a gong sound. It shifts pitch and timbre with the wind direction. The gong is like a bell buoy.

Wild sounds improvise with the gestures of the wind. These electronic voices create pitches sampled from comparing the amplitudes of the two anemometers. With stronger wind, the pitches occur in a wider range of frequencies. The wind direction determines the scales of the pitches chosen. Single-tone voices (notes) are activated when the winds slow. Larger envelopes of sound (lots of notes) are shaped, combined and faded up and abbreviated during stronger winds. These shaped envelopes of sound imitate the process of the wind forming sand dunes by pushing, dropping and sliding masses of particles. The total effect of these voices ranges from chatter to clusters of notes to surprising improvisatory singing and bellowing.

My second installation with this wind/sound synthesis system, *Windspun,* took place at Bronx Frontier Development Corporation's alternative energy site on the East River, in cooperation with Creative Time [4] (Fig. 2). A wind turbine powers the site-specific installation. The speakers are contained in the wind tower and tuned to resonate up and down the inner chamber. The piece is tuned to play in relation to the low shifting hum of the turbine's blades in motion. Birds nested inside the turbine and sang with the "voices" of the piece. One of the "drawbacks" was that at night, when the pitches were high, wild dogs came and howled at the piece.

In 1984, I made a piece called *Zephyr,* a wind-activated installation that communicated over larger spaces, using phone lines connected to anemometers to send information from two distinct locations

Fig. 4. ***Ginkgo Afterglow,*** **Safe-T Gallery installation: four paper banner speakers with pressed leaves made by Rii Kanzaki, photos of ginkgo leaves on pathway by Heidi Howard made into 15-ft-long wall print, radiometer field sensing light and motion using infrared light, MIDI-controlled synthesizer and amplifier, 2007. (Photo © Liz Phillips; courtesy of Don Burmeister, Safe-T Gallery)**

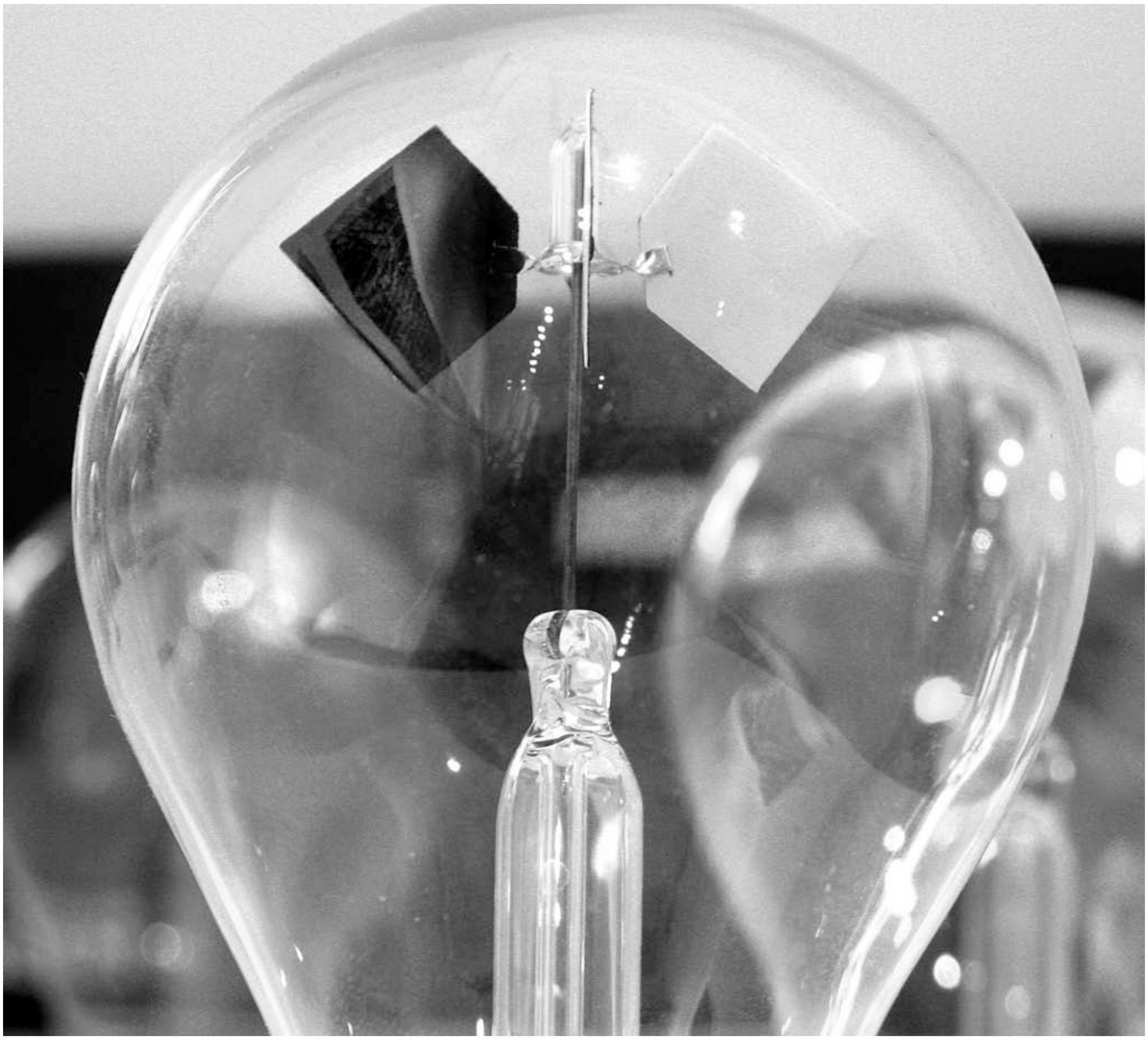

Fig. 5. *Ginkgo Afterglow,* Safe-T Gallery installation: detail of radiometer, 2007. (Photo © Don Burmeister)

in Minneapolis. The lobby of the Walker Art Center and the gallery of the University of Minnesota offered playback areas, and parts were broadcast by the college radio station. Anemometers and weather-vanes were set up outside of both locations, with the data sent on phone lines through a homemade modem. Changes in wind speed and direction and weather across the city are audible. Because of the new possibility of communicating worldwide through satellites and the Internet, larger weather installations can now be modeled.

W*avetable* (2003) elaborated on my exploration of waves (Fig. 3). In *Wavetable* an aluminum table is tuned like a steel drum, with resonant frequencies, and played by a transducer attached to the bottom of the table to move the water in the table into visible wave patterns and to create tuned audio voices. This table emanates two kinds of responses to the ambient sounds picked up by a single microphone. The first response comes from low-frequency oscillators tuned to the resonant frequencies of the table. All these low frequencies make different waves. Waves fade up and down in response to audience loudness, pitches and the sequence of events (using several envelope followers and their inverse integrated [smoothed] curves). The second kind of audio is digitally delayed and transposed audio voices and whistles responding to the room's ambience. A homespun limiter function makes the quietest sounds in the room enough to create changes in the table's waves. The audience talks, walks, sings and whistles, constantly shifting ranges and responsive voices (whether consciously or unaware). The system responds in multiple ways. It also takes the loudest sounds and lowers them to create a minimum of controlled feedback. There is a call-and-response relationship between the wavetable and the audience. The tempo of events and curves of response are a result of the coordination of the audience and the parameters and tunings of the electronic sound system. It is always changing and must be reconfigured in each location.

Ginkgo Afterglow (2007), first installed at Safe-T gallery in Brooklyn, used radiometers and infrared to pick up audience activity and changes in light to make sound that was played back through homemade paper and dry leaf banners, which became the loudspeakers (Fig. 4). Rii Kanzaki (who created the paper with pressed gingko and maple leaves) and I stretched these paper speakers at angles across ceilings and down walls to cause sound to emanate throughout the

Fig. 6. ***Elastic Space*****, performance/installation, bronze screen, armature wire, capacitance fields, computer, synthesizer, speakers, amplifier, pedestals, 2008. (Photo©Jodi Chang) This work in progress was created in the Sculpture Atrium at University of California at Santa Barbara, as part of my IHC Residency project in January 2008. Audience/participant Adam Cruz is first to connect into the human sculpture.**

gallery. The sound comes from samples of walking on paths of dry leaves and particles scattering. The sounds are activated and shifted by changes in the air, light and heat in the gallery. An array of radiometers (Fig. 5) and infrared sensors shift the MIDI controls. There is also a 15-foot-long print (made from photos by Heidi Howard) of fallen leaves on a pathway. The sound installation is intended to capture the scattered leaf pattern and yellow pool of light that I observed on the pathway. Leaves and paper share a common sound character that transposes well through the paper speakers in this installation.

Elastic Space (2008) was first shown as a work in progress during my residency at the University of California, Santa Barbara, in the sculpture atrium (Fig. 6). The sensors' data can self-adapt to changing conditions in the gallery. *Elastic Space* uses the capacitance fields radiated and received from a group of four brass screen objects/sculptures on pedestals. I used armature wire to create the simplest forms and sew the screening to them. Their specific size and shape creates fragile human-scale fields with which an audience can interact. Slight changes in activity between these objects alter the sound in the space. Sound is constantly evolving based on accumulated activity processed by the computer program. A hybrid computer system collects information to create extremely elastic MIDI controls directly from the radio oscillator information. In another rendition of this project, I attach wire to volunteer performers from the audience so that they become transmitters and receivers on the pedestals. As the performers change position, they shift the shape and sound of the fields radiated around them. Other audience members/participants move in to be a part of this dynamic audience sculpture.

Wind and Energy, Future Projects

As a result of limited fossil fuels, worldwide demand for clean renewable wind energy is rapidly increasing. Setting an example, Denmark currently receives 20% of its electricity from wind and plans to reach 50% [5]. With the increase in turbine production, there is greater space for an artistic response. New potentials for harvesting energy from waves, using piezo fibers so that the motion of the waves can create enough energy to run microcircuits, suggest the possibility of setting up monitoring stations on the oceans. New types of rechargeable batteries can store sun and wind energy for continuous transmissions. I hope to use my sensitivities to nature, space and technology in my future work to celebrate these new energy sources.

References

1. <en.wikipedia.org/wiki/Nightingale_floor>.

2. <en.wikipedia.org/wiki/Theremin>.

3. <www.medienkunstnetz.de/works/hearts-beats-dust/>.

4. Creative Time, a not-for-profit art organization, helped to sponsor the opening events, publicity and posters and act as a financial sponsor for this work.

5. Simon-Philippe Breton and Geir Moe, *Renewable Energy: An International Journal* **34**, No. 3 (2009) pp. 646–654.

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New York-based artist Liz Phillips (b. 1951) has been making interactive multi-media installations for the past 40 years. Phillips received a B.A. from Bennington College in 1973. In 1981, she co-founded Parabola Arts Foundation, a not-for-profit organization that provides funding for art-related projects. Phillips has made and exhibited interactive sound and multimedia installations at venues including The Whitney Museum of American Art, Milwaukee Art Museum, the San Francisco Museum of Modern Art, the Spoleto Festival USA, the Walker Art Museum, Ars Electronica, Jacob's Pillow, The Kitchen and Creative Time. Phillips has also collaborated with many artists, including the Merce Cunningham Dance Company, Nam June Paik, Earl Howard, Yoshimasa Wada and Alison Knowles. She also teaches classes in sound and interactive media at Purchase College and curates sound and space exhibitions.