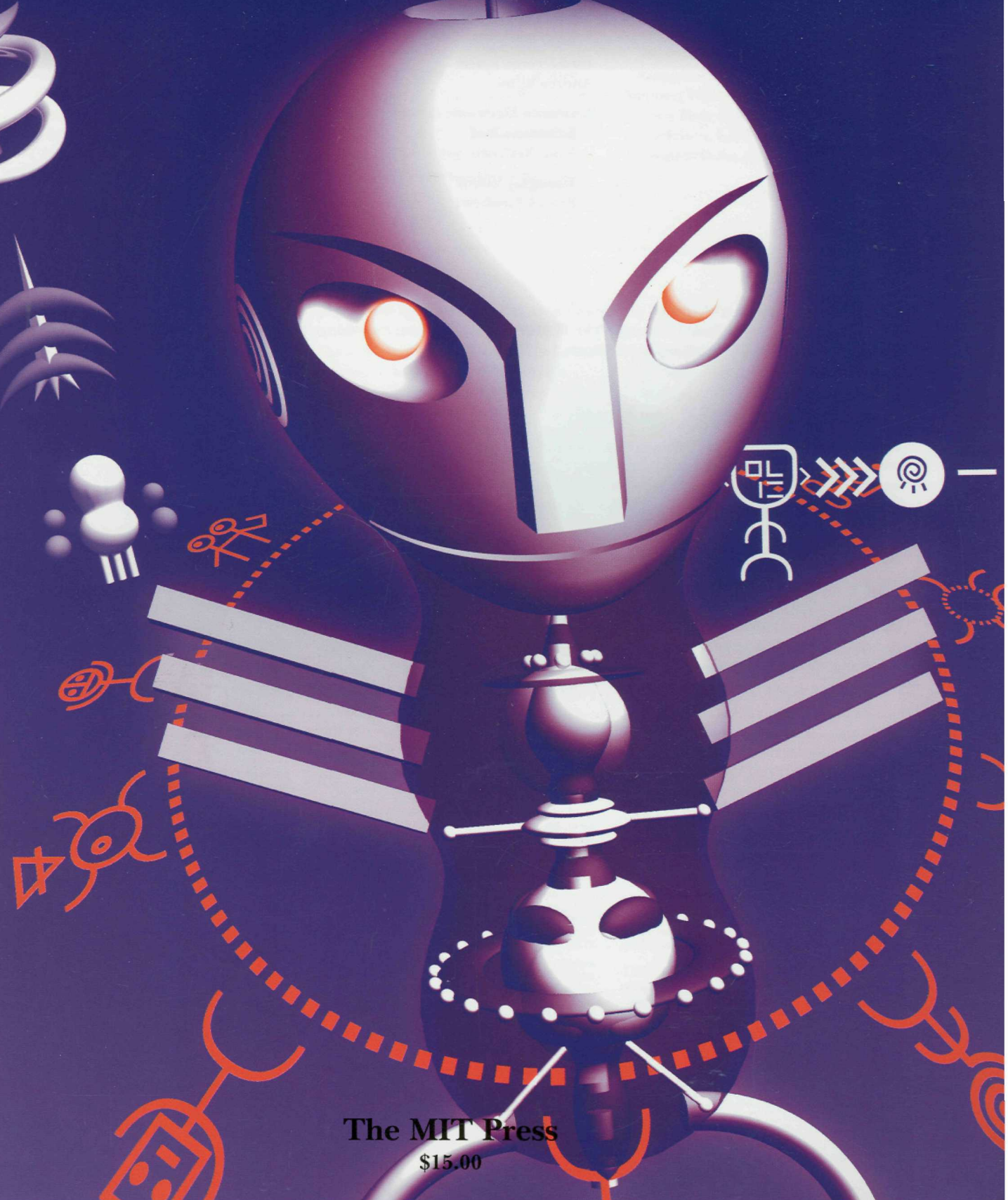


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MORI: AN INTERNET-BASED EARTHWORK

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All flesh is grass.

—Isaiah (40:6)

In *Mori*, minute movements of the Hayward Fault in California are measured by a seismograph, converted to digital signals and transmitted continuously via the Internet to a sound installation. Inside the entry curtain, visitors follow a fiber-optic cable to the center of the resonating enclosure where a portal through the floor frames the installation's focal point. An embedded visual display and immersive low-frequency sounds are modulated by the unpredictable fluctuations of the earth's movement.

The University of California (U.C.) at Berkeley's Streckeisen STS-1 seismometer measures ground velocity in 3 orthogonal directions (x, y, z). A Quanterra Q935 datalogger digitizes the data stream, sending three 4-byte integer values 20 times per second (about 2 kbps). This data stream is sent over dedicated lines to the U.C. Berkeley Seismological Laboratory. A Pentium II server at U.C. Berkeley's Industrial Engineering and Operations Research Department, <Memento.ieor.berkeley.edu>, makes a socket connection to a machine at the station to receive the real time data stream. Memento also runs the Apache Internet server for the online visual interface, which distrib-

utes Java applets to web clients. Client applets establish connections and receive continuous data streams, displayed as a ghostly monochromatic trace. Client displays are delayed 30 seconds due to buffering that provides visual continuity.

At the sound installation, another PC receives seismographic data using a second data feed from the Seismological Lab. This PC runs a visual display at the installation and outputs data in MIDI format to a Macintosh G3. The G3, running the Cycling 74 MAX/MSP software, processes the signal to modulate environmental sound samples such as rockslides, volcanic eruptions, thunderclaps, avalanches and industrial noise. The installation houses a five-channel sound system, including a powerful sub-woofer beneath the floor that transmits sound through visitors' bodies.

The sound is "conducted" by the live seismic data, including density, spectral characteristics, amplitude and spatial-

ization. The z signal is used to shape the amplitude of the sound, creating a sonic waveform that is a direct analog of the visual display. The z signal also filters the frequency mix to add visceral, low-frequency sound components. The x and y signals are used to focus eruptive sounds at the center of the installation and to pan sounds from sustained samples through the space. Samples are slowed considerably to suggest reverberation deep within the Earth.

The fiber-optic guiderail is illuminated by a metal halide lamp, which is intermittently obstructed by a wheel driven by a MIDI-controlled stepper motor, so that high-frequency flicker corresponds to large-amplitude z motion (Fig. 1).

Mori was selected for the ICC Biennial in Tokyo and then exhibited as part of Telematic Connections, a traveling ICI show organized by Steve Dietz of the Walker Art Center.

Fig. 1. Ken Goldberg et al., interior, *Mori* acoustic installation, NTT Inter-Communication Center, Tokyo, Japan, 1999. (Photo © Takashi Otaka)

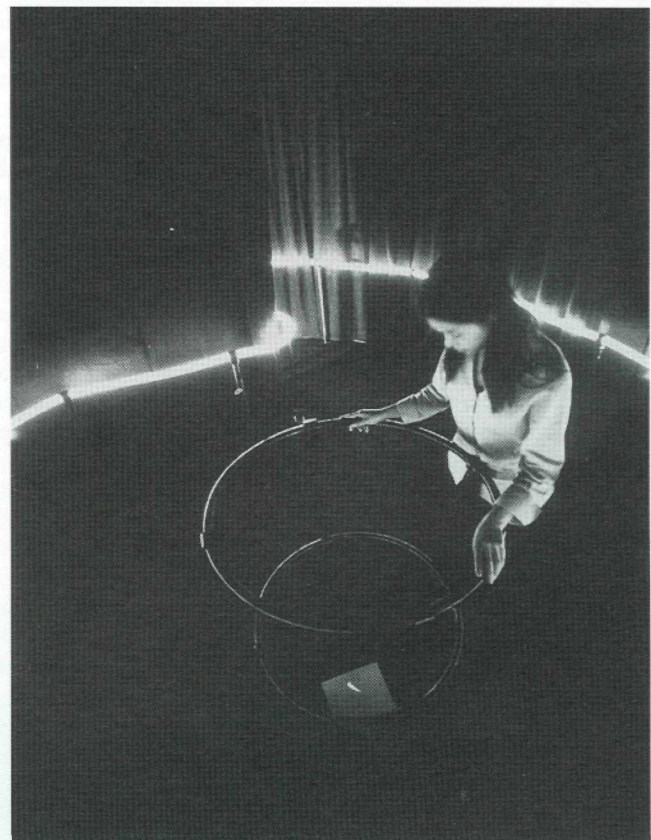




Fig. 2. Stan Shaff, AUDIUM, 2000. AUDIUM's interior performance space, wherein compositions are performed spatially through 169 speakers. (Photo © Mark Akamine)

The title links the Japanese term for "forest-sanctuary" with the Latin for "reminder of mortality." In this Internet-based earthwork, the immediacy of the telematic experience challenges the authenticity of media in the context of chance, human fragility and geological endurance.

The visual interface is on-line at <http://memento.ieor.berkeley.edu>.

AUDIUM: SOUND-SCULPTURED SPACE

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For over 40 years, Douglas McEachern and I have been exploring the language of space in music. The core of our concern is that sound, in its movement through space, defines new, provocative relationships. The composer becomes sound sculptor: direction, speed and intensity require a new musical vocabulary.

The interaction between compositional needs and technological innovation led us to the creation of AUDIUM, variously described as a theater of sound-sculptured space or a sound-space continuum. Located in San Francisco, AUDIUM is a total environment, designed from floor to ceiling as an integrated concept.

The theater, open since 1975, consists of a foyer, a sound labyrinth and a main performance space. It is a building within a building, conceived exactly for this art form. Listeners sit in concentric circles, enveloped by 169 speakers in sloping walls, a floating floor and a suspended ceiling (Fig. 2). Sounds travel above, around, below and on multidimensional planes in space. Exact control of sound movement, direction, speed and intensity is realized through a custom-designed electronic console, responsive to a "tape performer." Live, spatial performance of tape compositions allows each performance to be unique. Listeners are immersed in a kinetic sound realm wherein speakers and environment become the new electronic orchestra.

The idea of AUDIUM began taking shape in 1958, when Doug McEachern

and I met. We were both musicians and teachers with traditional music backgrounds. I was working with audio tape (natural and electronic sounds) and becoming concerned with the spatial aspects of composition and perception. Doug's knowledge of electronics enabled him to develop original equipment systems for live, spatial performances.

In the beginning, we operated with a simple performance console, allowing for spatial movement among a limited number of speakers. We held several public performances in San Francisco colleges and museums beginning in 1960. Gradually, we developed a strong philosophy about the effect of the total environment on the composition. This led us to create our first permanent theater, open for 3 1/2 years beginning in 1967.

In our second and current theater, we received the opportunity to build on what we had learned with seed money from the U.S. National Endowment for the Arts. We have been offering weekly public performances and occasional college seminars since 1975.

Through AUDIUM, we have sought to bring listeners physically inside a sound world, where they can experience sounds as kinetic, sculptural, shaping energies. As sounds travel in total darkness, they create textures, colors and forms. Polytonal writing allows chordal clusters to interact on different levels in space. Through the workings of sound tensions and releases, the pushing and pulling of harmonics, the audio space expands and contracts.

A melodic line acquires a starting point, a speed, a determined pathway and a point of conclusion. Areas in space become launching sites and meeting stations for converging sound lines. Melodic convolutions can be physically felt as they flow along spatial planes—vertical, horizontal, diagonal, circular and any desired combination thereof. As each melodic line travels, layers unfold, overlap and entwine to reveal a rich audio tapestry.

In seeking to understand the language of space, we hope to have brought new perceptual understandings to a largely neglected dimension in the vocabulary of music.