# ICMC 2004 Keynote Address COMPUTING AND COMPOSING SOUNDS

***Jean-Claude Risset***

*Editor's note: Risset's keynote was originally accompanied by audio and visual aids that cannot be reproduced here. Therefore, the text has been slightly modified; however, the descriptions of the sounds remain.*

I am pleased and honored to speak here and now at ICMC, 40 years after David Wessel convened the first computer music conference. Computer music has expanded over the entire world, but it was born and reared in the United States. I come from France; France has become very active in computer music, as witnessed by IRCAM and GRM in Paris, and other centres such as GMEB in Bourges, GRAME in Lyin, ACROE in Grenoble, and GMEM and LMA-CNRS in Marseille. I am grateful to the United States, where I made most of my own research contributions.

For almost half a century now, the computer has been used to generate and transform musical sounds through computation, using processes similar to those used for texts, images and gestures. This has brought new creative potentialities, which have only barely been touched upon.

Max Mathews, here playing his radio baton, first performed digital recording and computer sound synthesis in Bell Laboratories in 1957.

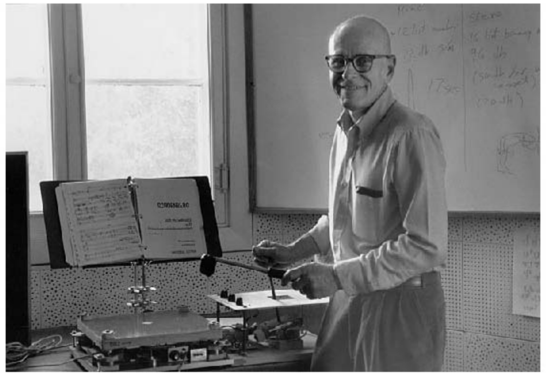

*Fig. 1 Max Matthews with his radio drum*

Mathews was helped and protected by John Pierce, who directed research at Bell Labs. Pierce pioneered traveling wave tubes, PCM, satellite communication, and coined the word transistor. He is in the center of this photograph, along with Mathews, Jim Tenney (the first composer in residence at Bell Labs), and myself. I succeeded Tenney in 1964 to explore the musical possibilities of computer music synthesis.

*Fig. 2 Risset, Mathews, Pierce, Bell Labs 1965*

Thanks to the quest for creative innovation led by engineers and avant-garde composers, the computer has been able to develop exciting novel possibilities. Resorting to the computer has brought new ways to extend the sonic vocabulary of music.

The digital domain has remained marginal in music for several decades. Today, digital processes are central in the dissemination of existing music through CDs, and, more recently, mpeg coding, which is used extensively on the web. This is fine, but digital technology should not be restricted to the reproduction of the existing. As Varèse liked to say, new materials permit and call for new architectures. With plastics, one can do better than just fake wood; the quest of novelty is more exciting than the task of mimicking. The creative interest is in *broadening musical horizons*.

I make a plea for computer music to continue to be innovative and not restrict itself to reproduction. Rather than arguing—we shall have several round table discussions—I shall try to make my point by presenting a number of brief examples (in particular of my own work) to illustrate new musical situations that only the computer made possible.

In my discussion of computing and composing sounds, I shall talk about (1) shaping or sculpting sounds, (2) associating sounds and images, (3) controlling music through gestures, and (4) composing sounds for perception.

First, let us consider shaping or sculpting sounds. Clearly, sounds and music can be generated according to various models, as exemplified long ago by the late Iannis Xenakis. Digital processes of various kinds can be used to generate sounds; this is the basis of the process of "sonification," also discussed at this conference. One can set up situations that seem contrary to the rules of physics. For instance, digital filters can be non-causal. In the following sound example, bird's caws will excite resonant filters. The response follows the excitation, but the response can be made to precede the excitation as well.

Computer music permits one to do both concrete music (processing recorded sounds of acoustic origin) and electronic music (synthesising sound material with controlled parameters without an acoustic source). My own computer music work used mostly synthesis until I realized *Sud* at GRM in 1984. This piece attempts to merge *musique concrète* and electronic music (digital processing and digital synthesis), and I shall give two examples from it. In the first, the energy flux of sea waves shapes the mixing of synthetic tones. In the second, harmonic pitch grids composed like chords are imprinted upon any unpitched material. Synthesis and processing are intertwined to generate hybrid textures.

Now, I shall discuss associating sounds with images. Similar controls can be applied to both musical sounds and images, as exemplified by the late composer Emmanuel Ghent in his work with Jim Seawright and the Mimi Garrard Dance company. The great artist Lillian Schwartz realized several computer films and videos with computer music. I shall present an excerpt of the film she realized in 1970 on my piece *Mutations*. We shall first see laser beams diffracted through plastics, briefly interrupted by crystal growth, and then, at the end, colored dots that move in different places and gather at different times: a process of dispersion concentration. This is a process I had used in my piece *Mutations,* where fast tones have occasional rendezvous in pitch and time. In her film, Lillian Schwartz elected to use the same process at a different time, as a counterpoint rather than a harmony, to avoid sound and image tautologies.

Physical modeling provides natural ways to correlate sound and image, as shown in the pioneering work of Claude Cadoz and Annie Luciani. Solving the equations for a simple mechanical system gives the following sound result. It is quite characteristic. A vibratory system can be modeled in the computer. Solving the equations provides time-animated images and evolving sounds, which bear a straightforward relation because of their common origin in virtual physics.

Now, I will talk about controlling music through gestures. Performers are essential to bring life to music. Performance is all-important in computer music too.

The gestural control of music can been programmed in unprecedented ways. The computer permits one to “map” at will certain gestures to certain aspects of sound. Here one must mention the work of many pioneers, especially Max Mathews, Jon Appleton (who contributed to the design of the digital synthesizer Synclavier and who took it on the road), Joel Chadabe (who pioneered interactive composing), Barry Vercoe, Miller Puckette, and David Zicarelli.

With the hybrid real-time system GROOVE, Mathews and Moore have provided a control of the music that can be programmed so as to implement various models: the organ player model (one gesture, one note), the CD player model (one gesture, all notes), the "Music minus one" model, and the orchestra-conductor model. Combining different models provides flexible ways to specify performance nuances. It also helps to study what performers do. We shall hear a performance of a brief section of Ravel's quartet, realized in several successive sessions by two “performers.” Clearly, the system allows varied nuances and musical options to come through.

In Laboratoire de Mécanique et d'Acoustique of CNRS in Marseille, Daniel Arfib and his students study various ways to capture gestures and to map them into musical parameters. I shall present some brief demonstrations of their work.

First, Fabrice Gagneux plays “virtual percussion”—hitting nothing, but not in vain. Virtual percussion can be implemented in various ways. In the example we just saw, accelerometers follow the wrist motions of the percussion player. Second, Loïc Kessous uses a graphic tablet as a “voicer” to control a voice-like sound. Third, using the mathematical concept of sieve (in French *crible*), Jean-Baptiste Millien has set the computer to elaborate on his rhythmic suggestions. Finally, Jean-Michel Couturier has implemented a graphic interface for a personal real-time control of scanned synthesis, a new synthesis process invented recently by Max Mathews and Bill Verplank.

Real-time has enabled the computer to perform live with instrumentalists and to accompany them. Score following was initiated by Barry Vercoe, who worked on his “synthetic performer” around 1981, and by Roger Dannenberg. In order to implement score following more easily, Miller Puckette developed the MAX programming environment and used it in works such as Philippe Manoury's *Jupiter* and *Pluto*. In the following example from my piece *Echappées*, Denise Mégevand plays the celtic harp alone at the very beginning. Then, her playing is amplified thanks to the Max/MSP software.

Working with Scott Van Duyne at the MIT Media Lab in 1989, I pursued the instrument-computer interaction in the acoustic domain, realizing *a Duet for one pianist*, in which the live pianist is accompanied by an invisible partner who plays—on the same acoustic piano—an accompaniment that depends in various ways upon what the pianist plays and how. In the following example, the louder the pianist plays, the faster the accompanying arpeggio—a novel and playful interaction.

Real-time is great, but it can be a mixed blessing. Works that use it rely on advanced technologies that are often both idiosyncratic and ephemeral. One should be aware that technical obsolescence tends to make these works short-lived. Several works realized on the IRCAM's real-time audio processor 4X can no longer be performed. There are maintenance problems even with well-structured software. I discovered this morning that Wuan Chin-li's paper in ICMC04 is dedicated to the problem of getting the MAX patches of my *Duet for one pianist* to work on his computer. Several pianists performed this Duet, but this required updated documentation, expertise and hard work! In contradistinction, pieces for "tape" survive: the process of recording will always be ported to more recent technologies, such as CDs, DVDs, and hard disks. Also, real-time operation, great for performance, can be hard to resist, even though genuine musical composition implies freeing oneself from the constraints of real-time.

My final chapter—not the least—will return to elaborating, but specifically for the ear's sake, keeping perception as the constraint and the criterion. I shall present some instances drawn from the work of John Chowning and from my own work. These examples were realized using variants of Mathews's modular "Music-N" programs, which enable the user to design complex musical sounds in various ways. Digital synthesis and processing allow us to perform microscopic control on the sound material. Going beyond the assembly of pre-existing sounds, one can apply compositional processes at the sonic level and literally *compose sounds themselves*. The exploration of synthesis has deepened our understanding of the schemes of auditory perception, and thus unfolded new aesthetic possibilities. This leads to a field of inquiry for which John Chowning has coined the expression "Sensory Aesthetics." The examples are not recent, but many of you may not know them, and I contend that they still hold potential for future developments. A lot of research is being pursued on hearing, but it is rarely linked with the creation of novel music.

Computing sounds permits one to escape the constraints of mechanically vibrating sound sources and to take advantages of the idiosyncrasies of hearing to give rise to illusions. Chowning and I have used this possibility, which strongly interests György Ligeti.

*Ligeti, Chowning, Sylvia Fomina and Risset at Stanford's CCRMA.*

Thus, Chowning strongly suggests an illusory rotation in space in his 1972 work *Sabelith*, and at the same time a continuous timbral metamorphosis: unpitched percussive sounds turn into brassy tones. The loudspeakers are fixed, but for our ears the source of the sound does move. "The illusions are errors of the senses but truths of perception," as Purkinje said, and "music is meant to be heard," as Pierre Schaeffer liked to say.

In the next example, we hear a recording of soprano Irène Jarsky singing in a rather dry studio. Then, the recording is transformed in simple ways—by echoes—to make her voice spread into a larger virtual space.

In his work *Turenas*, Chowning suggests illusory motions with quasi-graphic precision, using auditory cues for localization and speed, and in particular the Doppler effect. This would be much more impressive if instead of stereo we could hear the 4-track for which Chowning composed the piece.

Auditory perception is sometimes unintuitive and surprising. In the next example, which is higher, the first or the second tone? Listeners usually hear the second tone a little lower - about a semitone. However I go from the first tone to the second tone, judged lower, by doubling all frequencies—by going up a physical octave.

David Wessel has shown that hearing has special ways to sort sounds, so that a change of timbres may completely change the melodic structure of an otherwise unchanged sequence. The research of Wessel and others is precious to explore timbral space, a space that is continuous and unbound thanks to synthesis.

Clearly, one must take the idiosyncrasies of hearing into account, so that the musical intention is conveyed to the listener. But these oddities of hearing permit one to construct paradoxical sound sequences similar to Escher's paradoxical images. Here, the stream seems to flow down, yet it reaches a higher point from which it falls as a cascade. The following sound sequence seems to go down in pitch, yet it is higher at the end. It also seems to slow down; however, the beat is much faster at the end. (This example also seems to rotate like the example from *Sabelith*.)

Synthesis provides sonic material of unprecedented ductility, and this opens interesting musical possibilities. In the beginning of my piece *Mutations*, the same motive is used for melody, harmony and timbre. One can then compose timbres just like chords. Synthetic bell-like tones can be turned into fluid textures with the same inner harmonies. This is an intimate transformation.

The four last examples exemplify the ductility of the synthetic material. One can *extrapolate* beyond usual values of sonic parameters, like Chowning synthesizing an extreme *basso profundissimo* voice. One can also *interpolate*, transform, morph; for his piece *Phone*, Chowning's "bells" gradually turn into voices. One can also *stage close encounters* between instruments and synthetic sounds. In the following example, instruments appear like filigree within synthetic tones. Acoustic sounds are audible traces of a visible world, unlike synthetic sounds, which only suggest an illusory world—a separate, internal sonic reality that can also be appealing. When these realities meet, identity can sometimes be an enigma, as in this last example, where the flutist sings into the instrument—flute or voice? Also, the synthetic tones become quasi-vocal—the voice of whom?

"Beauty is in the eye of the beholder." The musical aesthetic experience is our ears and brain. Technology grows according to its own logic, but it can provide us with great resources. Such resources are especially wonderful when they are tailored to help us explore and enjoy unexplored worlds, our inner worlds. That is our task in computer music.

## ICMC 2004 Concert Reviews University of Miami Concert 5

***Rosemary Mountain***

The fifth concert of the ICMC was one of the most diverse of the week, both in aesthetics and in presentation. It showed the full array of options, including sound+DVD, sound+dance, live+recorded, computer-generated, and improvised. There was also a certain array of quality, but most of the pieces held my interest for one reason or another.

*Id-fusiones* by Rodrigo Cadiz was, for me, one of the highlights of the week, due mainly to the innovative treatment of the image-sound correlation. As it becomes increasingly easy to achieve millisecond coordination between audio and visual, the number of failing attempts to combine them convincingly seems to multiply. The perceptual issues involved are still seriously under-researched, but one of the most common factors in producing a sense of poor correlation is the discrepancy between sound and image space. (As this sense is often subliminal, the auditor/spectator may be left with the impression that the piece is simply not very good.) In many cases, multiple-speaker diffusion is in clear contradiction with the portrayal of a virtual 3-D space that is more distant than the sound, and typically viewed through a small, front-centred window. Cadiz neatly circumvented this entire trap by presenting the visuals, at first, like a kind of typewriter notation on a two-dimensional surface coinciding with the screen itself. The manifestation of time was often represented by the single placement of images like letters on the page, usually (but not always, thankfully) in sync with rhythmic aspects of the sound. The typewriter analogy gave way to a more poetic dance, as lines of the pattern were initiated from the right side of the screen and moved left—"backwards" for those of us immersed in the "time as *x*-axis" reading mode. Likewise, colour and size lent character to the sonic layers, which were often, but not always, in keeping with the sonic line. When sound and image diverged, however, one was led to appreciate the counterpoint in full anticipation of their impending resolution into homophony and/or rhythmic consonance. My ears and brain were particularly attracted to a section of the piece that was filled with individual sonic components whose initial fluctuation was balanced with long sustained notes focussed on a single unwavering frequency, reminiscent of certain Indian performance aspects. My aesthetic preference for less continuous sonic glides and nebulous frequency masses in favour of more precisely defined