Goffredo Haus, with Nicola Bernardini, James Dashow, Giovanni De Poli, Eugenio Giordani, Mauro Graziani, Richard Karpen, Andrea Libretti, Curtis Roads, Maurizio Rubbazer, Nicola Sani, Sylviane Sapir, Daniele Torresan, Barry Truax, Elio Verdi

Report from the 1984 International Computer Music Conference

The 1984 International Computer Music Conference (ICMC) was held 19–23 October at the Institut de Recherche et Coordination Acoustique/Musique (IRCAM) in Paris, France (Fig. 1). David Wessel was the conference organizer. (Wessel also organized the first ICMC at Michigan State University in 1974.)

The 1984 ICMC was aided by the French Minister of Culture, the city of Paris, the Groupe d'Acousticiens de la Langue Française (GALF), the Finnish Ministry of Education, the Finnish Foundation for the Creative Arts, and the Netherlands Ministry for Welfare, Health, and Cultural Affairs. This conference also enjoyed the support and collaboration of Radio France, the Institut Nationale de l'Audio-Visuel and Groupe de Recherches Musicale (INA/GRM), the Computer Music Association, and *Computer Music Journal*.

The 1984 ICMC incorporated many sessions, concerts, and satellite events. Besides the events reviewed here, three afternoon tape music concerts were scheduled, in addition to a continuous listening session on three successive days and no less than 29 poster papers on various musical and technical subjects.

Friday Evening: Concert at Centre Georges Pompidou, Reviewed by Elio Verdi

The first event of the conference was a performance of Pierre Boulez's *Répons*. Boulez, the director of IRCAM, assembled a veritable army of resources in the form of instrumentalists, technicians, musical assistants, and high technology in order to realize this work over the past four years. *Répons* has been a work in progress since 1981, when it was first performed in Germany. A definitive version is planned for the 1985 American tour.

The piece is written for three groups: an ensemble of 24 instrumentalists (the Ensemble Inter-Contemporain), six soloists (playing piano, harp, cimbalom, vibraphone, xylophone, and glockenspiel), and an electronic group consisting of prepared tapes with live sound processing by the 4X synthesizer developed at IRCAM.

The title of the work is derived from the antiphonal question/response aspect of the composition. Soloists are pitted against the ensemble, and all the instrumentalists are at times pitted against the electronic parts. Although the writing was sometimes dense and detailed, the orchestration remained largely transparent—a Boulez trademark by now.

Répons spans over 40 min and the instrumentalists performed superbly throughout. Special mention must be given to Andrew Gerzso, Boulez's musical assistant, for his painstaking work in bringing *Répons* to the stage.

Saturday Morning: Studio Reports I, Reviewed by Goffredo Haus

In the narrow space of 20 min John Chowning presented the studio report from the Center for Computer Research in Music and Acoustics (CCRMA) at Stanford University. The equipment presently available includes a Foonly F4 computer, six MC68000-based Valid Logic workstations, the Systems Concepts synthesizer, sixteen graphic terminals, and four large disks. The workstations, which run Unix and the UCSD CARL music software, are interconnected via Ethernet and are equipped with

Translated by Marco Stroppa and James Dashow.

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Fig. 1. Session at the Espace de Projection, IRCAM. (Photograph by Patte Wood.)

MIDI interfaces and associated Yamaha DX7 synthesizers. With the collaboration of the Xerox Palo Alto Research Center (PARC), CCRMA is planning to develop music software on Lisp Machines.

The report from the Studio per l'Informatica Musicale (SIM) in Rome was presented by L. Del Duca, F. Galante, M. Lupone, G. Nottoli, and N. Sani. SIM consists of two studios. The signal-processing research studio includes a Texas Instruments (TI) 990/10 minicomputer with TI TMS 320 boards. The musical research studio includes an Apple II, and SPU-01 Pegasus personal computer with a dedicated software system.

The Electronic Music Studio (EMS) Stockholm, is dedicated to composition and musical production, with both analog and digital methods and instruments. The main studio includes a real-time digital synthesizer that can generate up to 256 sinusoidal oscillators. Thirty software programs for controlling the synthesizer emulate well-known analog modules, such as function generators, and sequencers.

Saturday Morning: Software I, Reviewed by Goffredo Haus

Curtis Abbott of Lucasfilm began by talking about flexible and efficient sound recording and playback using random-access digital disks. He then defined an algorithm for an optimal distribution of audio information throughout the disk. Abbott's algorithm minimizes the average search time. In particular, he quoted the example of a CDC 9766 disk drive (300 Mbytes). Abbott underlined the importance of "on-the-fly" scheduling for disk space. The following results have been obtained: 12–16 available channels at a sampling rate of 48 KHz, for a total of 20 hr of sound on-line using several drives.

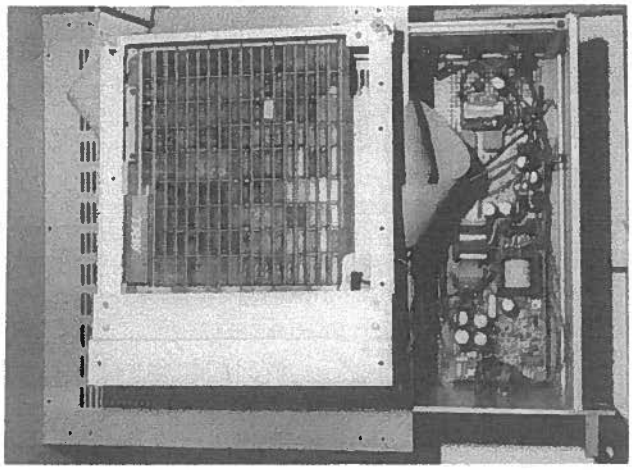
Jean-François Allouis (GRM, Paris) presented the latest report on the Syter digital synthesizer project. The project includes a master computer (DEC LSI-11/23), a digital audio processor with two input channels and four output channels, a high-resolution graphics terminal with digitizer, and a disk unit used for sound recording. The Syter has five memories: a 2K 24-bit microinstruction memory, a 256K 24-bit wavetable memory, and three 2K 24-bit work memories. According to Allouis, Syter is being manufactured by the Digitone company in France.

Paul Berg (Royal Conservatory, The Hague) described his PILE4 language, implemented on a Digital Music Systems (DMS) DMX-1000 signal processing computer, controlled by a DEC PDP-11/34 computer. PILE4 considers musical compositions as a set of probabilistic procedures.

Roger Danneberg's (Carnegie-Mellon University) paper, "A Functional Approach to Real-Time Control," was one of the most interesting presentations at the conference. His ARCTIC system is a language for real-time control of temporal processes, based on the concepts of "prototype" and "instance." ARCTIC is meant to free the musician from the specifics of a particular computing system. Among the problems that ARCTIC solves are the temporal concurrence of processes, with and without human interaction. In other words, ARCTIC is a functional language in which time relations are explicit. An interpreter has already been implemented, and a compiler is under development.

Miller Puckette (M.I.T. Experimental Music Studio) talked about the M language for the definition of digital orchestras. Apparently M compiles into a Music 500 program that runs on an Analogic AP-500 array processor. Many graphic examples showed how to codify some of the most common

Fig. 2. The 4i real-time synthesis system at the CSC, Padua. (Photograph courtesy of CSC.)



instruments using M. According to Puckette, M coordinates communication among processes that have been combined with abstraction mechanisms. In the future, Puckette plans to implement the automatic declaration of static variables.

Robert Rowe (Amsterdam) described the characteristics of the language RECUR. RECUR is used for musical composition and sound synthesis based on "tree-structured oscillators" that generate recursively other oscillators at another level. Every oscillator is described by the following parameters: table function, high and low bounds, sampling increment, and on and off time. A DMS DMX-1000 can generate up to five of these oscillators.

Sylviane Sapir and P. Azzolini (Centro di Sonologia Computazionale [CSC], University of Padua) presented the 4i real-time software control system. The 4i (Fig. 2) is one in a series of digital signal processors developed by G. DiGiugno at IRCAM. The system uses both prerecorded scores and gestural commands, and is part of the musical network of the CSC. The system includes two parts: a symbol language to write musical scores, and a real-time monitor for management of data. According to Sapir, the main activities supported by the software include: music education software, optimization of synthesis algorithms, creation and editing of musical scores, and real-time performance.

Saturday Afternoon: Signal Processing I, Reviewed by Giovanni De Poli

The first two presentations of this session dealt with nonlinear sound synthesis. The other two presented a highly parallel modular architecture for sound synthesis. Aldo Borgonovo and Goffredo Haus (Instituto di Cibernetica, Milan) talked about "Musical Sound Synthesis by Means of Two-Variable Functions." This technique was originally proposed by Y. Mitsuhashi. Normal waveshaping transforms a simple signal by a one-variable function. In this technique, two simple signals are combined and transformed by a function of two variables. Thus, the output signal will retain some characteristics of the inputs, but with infinite possibilities for variation.

This technique is a generalization of the possibilities of waveshaping. Borgonovo and Haus have implemented the technique in an efficient way using wavetable lookup. Haus briefly presented the theory of the implementation on a DMS DMX-1000. He discussed the choice of the functions and the input signals, and showed the resulting spectra. Unfortunately, he did not present any sound examples. But he promised them for the next ICMC at the request of a conference attendee.

Next was a stimulating report by André Riotte (Brussels) entitled "A Computer Model for Continuous Transformation of Inharmonic Sounds." Riotte has a different approach. Instead of looking at the function, he uses a nonlinear difference equation taken from second-order differential equation (studied by Mathieu in 1868) to describe the vibration of an elliptic membrane. A very efficient algorithm for sound generation is thus obtained.

Riotte also described an implementation scheme for his technique on the 4X digital synthesizer. He also discussed the effects of the different parameters on the stability of the model and on the resulting sound, and presented highly convincing graphical and sound examples. Riotte's approach is particularly remarkable because the model is derived from a mathematical description of a physical phenomenon.

The next two papers dealt with a project at the California Institute of Technology concerning a

very-large-scale integration (VLSI) chip for sound synthesis. The first paper, "A VLSI Approach to Sound Synthesis," by J. Wawrzynek, L. Tzu-mu, and Carver Mead, described the theoretical basis of the project. They began with a simulation of the differential equations that model sounds. In order to achieve this goal, they designed an interconnection matrix between equal parallel processors. By changing the interconnections, they can change the algorithms. The basic processor (UPE) is implemented in n-channel metal-oxide-semiconductor (NMOS) technology and computes the function $a + bm + (1 - m)d$ in 32-bit fixed point. According to the authors, this function is well suited to most sound-synthesis algorithms, with the exception of reverberation.

The last paper in the session, "Models for Real-Time Music Synthesis Using UPEs," by H. Liu, C. Mead, J. Wawrzynek, and L. Dyer, continued the previous one. The authors dealt with the implementation of the most important synthesis techniques. It was demonstrated that grouping various UPEs makes it possible to obtain very complex instruments that are rich in musical possibilities. Liu's presentation featured an impressive series of examples that imbued the audience with hope for a better future for computer music.

Saturday Afternoon: Composition and Research I, Reviewed by Daniele Torresan

In "The Making of *Çoğluotobüsişletmesi*," Clarence Barlow (Cologne) (Fig. 3) discussed his piece for solo piano with a peculiar tuning. His work aims to isolate certain metric and tonal coeficients through an algorithm based on integer ratios. The sound examples, synthesized with Music 10 on the now-retired DEC PDP-10 at IRCAM, demonstrated an interesting use of a computer in the study and organization phase of a composition.

The next paper, "An Expert System for Schenkerian Synthesis of Chorales in the Style of J. S. Bach," by K. Ebcioglu (SUNY-Buffalo), demonstrated how to investigate the general rhythmic, harmonic, and melodic rules of creative composers. To explain his application, Ebcioglu showed the example of an analysis of Bach chorales realized by a series of algorithms that reproduce about 200 Schenkerian analysis rules. Unfortunately, the sound examples were not very effective.

Fig. 3. Clarence Barlow. (Photograph by Patte Wood.)

Steven Haflich (M.I.T. Experimental Music Studio) showed how the definition of musical entities and their relations within a computer may sometimes raise problems of compactness and functionality in writing the programs. Haflich is biased toward logic-programming techniques in Lisp to solve this problem. He held up two listings, one in English and one in Lisp. The Lisp program was about four times smaller.

Steven McAdams ended the session with a prototype of an expert system for the extraction of musical pitch of inharmonic sounds. His system uses the Terhardt algorithm that takes into account lists of amplitude and frequency values. The system is the first step toward research in timbral families. According to McAdams, when the sound to be analyzed is too complex, human intervention is still needed.

Fig. 4. Kaija Saariaho. (Photograph by Ann-Marie Stein.)

Saturday Evening: Concert at Centre Georges Pompidou, Reviewed by Barry Truax

The highlight of the evening concert by the Ensemble 2e2m, conducted by Paul Mefano, was clearly *Verblendungen* ("Dazzlings"), a work for small orchestra and tape. It was composed in 1982–84 by Finnish composer Kaija Saariaho (Fig. 4), who realized the tape part at the GRM. This powerful and carefully textured work is a steady-state piece with a strong underlying restlessness and upward motion that leads to the final ethereal disappearance of the first violin's glissando into the tape texture. Although the composer described the tape as "moving in the opposite direction (to the orchestra) with respect to the tone-noise axis," the tape seemed to expand the overall texture rather than lead an independent role.

Rolf Gelhaar's *Pixels* (1981), for four pairs of instruments (flute, clarinet, horn, cello) placed symmetrically in an arc, clearly articulated parallel micro-macro structure of "growth, decay, and mutation" in 64 sections of equal duration. Although two variants were layered, the effect was a sense of linear sequential form, articulated by a wide range of instrumental timbre leading to textures as the piece progressed. Computer-assisted composition of the piece allowed variants of the basic structure to be calculated by the composer, but this variety was largely constrained by a predictable time structure and by now "typical" instrumental timbre exploitation.

Computer assistance was less successful in the compositional process of Mesias Maiguashca's *Monodias y Interludos* (1984), or "Fmelodies," where the concept of frequency modulation (FM) spectral control is literally translated into instrumental pitch combinations, with the result of much parallel movement over a bass instrument "carrier."

The program also included the amateurish *Polifonia de Barcelona* (1983) by Chilean-born Gabriel Brncic. This piece consisted of two identical-sounding "movements" of continually repeated intervals. It left the audience, long-suffering in the poorly ventilated hall, drained of enthusiasm. On this evening only the passionate and youthful musicality of Ms. Saariaho's work provided nourishment to the arid reaches of contemporary instrumental music as represented here.

Sunday Morning: Studio Reports II, Reviewed by Goffredo Haus

The CSC in Padua has three main interconnected systems: the non-real-time system Musica, the interactive ICMS system, and the real-time 4i system. All of the systems can exchange musical scores as well as sound samples. CSC activity involves many computers: an IBM 370/158, an IBM S/7, a DEC PDP-11/34, a DEC VAX-11/780, and an Apple II. In addition to composition and research CSC supports an intense program of educational activity, both within the university and through short intensive workshops.

Fig. 5. Lindoro Del Duca (SIM, Rome) at the VLSI panel. (Photograph by Curtis Roads.)

The Computer Audio Research Laboratory (CARL) at the University of California, San Diego (UCSD) presented a report by Mark Dolson, Gareth Loy, and F. R. Moore. CARL has developed a music software system that is by now widely distributed throughout the world. The software is written in C and runs under Berkeley Unix. Ongoing research at CARL focuses on signal processing, real-time sound synthesis, composition languages, and microprocessor-based workstations using MIDI.

The report from the Computer Music Laboratory of Technion (Technical University of Israel) was presented by Y. Yehuda and U. Shimony. Their system is designed for a real-time audio computer called AMOS that generates 256 musical voices. AMOS is controlled by a general-purpose computer and is biased toward additive synthesis.

Panel: Large-Scale and Very-Large-Scale Integrated Circuits for Sound, with the participation of Mark Kahrs, Lindoro Del Duca, Goffredo Haus, Katsuhiko Hirano, F. Richard Moore, Xavier Rodet, John Snell, and John Wawrzynek, Reviewed by Maurizio Rubbazzer

Xavier Rodet (IRCAM) and Lindoro Del Duca (SIM) (Fig. 5) talked about aspects of using the TI TMS 320 chip for musical purposes. A general structure for sound synthesis was proposed and a few algorithms for this goal were presented. The problems met during the implementation were highlighted, such as the TMS 320's poor frequency resolution for low frequencies, which results from making oscillators from second-order resonating filters.

K. Hirano (Yamaha) (Fig. 6) briefly discussed the working principles of the VLSI chips YM-2128 and YM-2129. They are respectively an FM "operating unit" and an envelope generator, and they are built into all Yamaha digital synthesizers (CX5, DX1, DX7, DX9, TX8).

F. R. Moore (CARL) and John Wawrzynek (California Institute of Technology) (Fig. 7) verified that it is now possible to design complex VLSI circuits thanks to such tools as silicon compilers and circuit emulators. The main problem is the expense of producing the physical circuits. They also stressed the use of standard interfaces such as buses that are well suited to signal processing.

John Snell (Lucasfilm/Droid Works) reinforced the points made by Moore and Wawrzynek. He brought as examples some custom chips produced by Lucasfilm, including a multiplier used in the Lucasfilm Audio Signal Processor. Goffredo Haus (Milan) then talked about the problem of designing VLSI circuits that deal with a higher level of abstraction for musical processes, and chips that aid interaction with computer graphics.

At the end of the panel session, Mark Kahrs (AT&T Bell Laboratories) summarized the main problems met in designing VLSI circuits for musical purposes. Besides cost limits, the main problems are: the choice of algorithms, the choice of a floating-point or a fixed-point representation for sig-

Fig. 6. Katsuhiko Hirano (Yamaha) at the VLSI panel. (Photograph by Curtis Roads.)

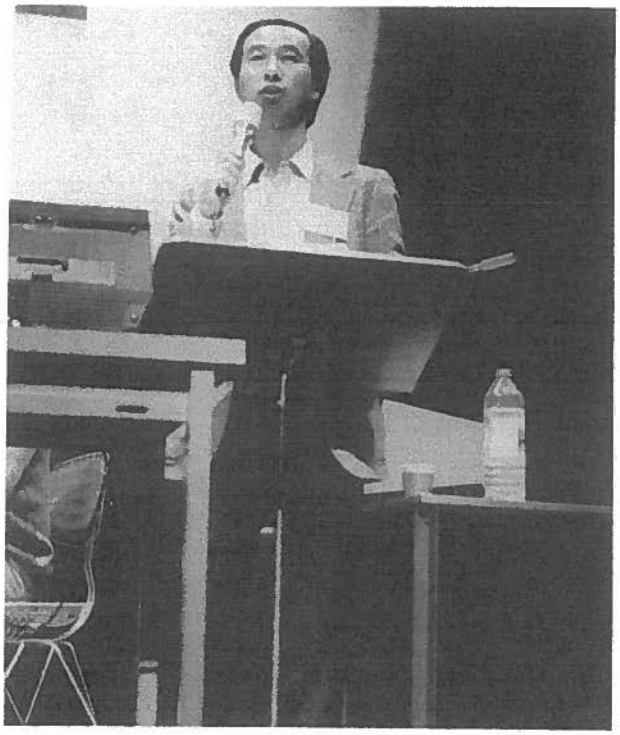
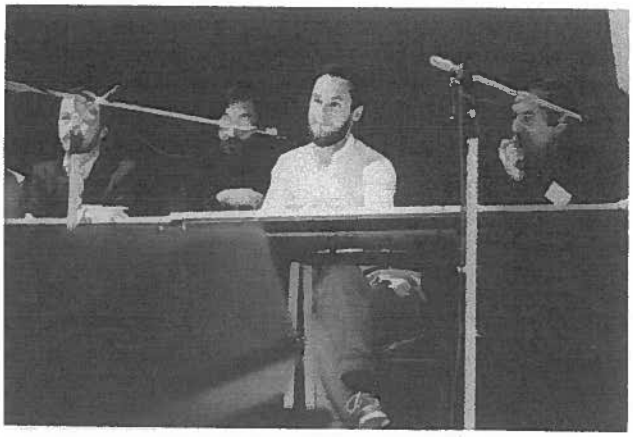


Fig. 7. At center, John Wawrzynek (California Institute of Technology) at the VLSI panel. (Photograph by Curtis Roads.)



nals, and the specification for parameter update speed (important for real-time work). At an architectural level, a choice must also be made between a parallel structure using many processors and a serial structure. Great importance was given by all to the interconnection problem, both inside the chip and between different chips in the system. A brief but interesting debate followed between the audience and the panelists.

Sunday Morning: Control in Live Performance, Reviewed by Sylviane Sapir

The two last Sunday sessions were dedicated to the problems of expressive control, that is, to everything that deals with the real-time performance of digital compositions. This includes problems of interpretation and accompaniment of solo instruments. In the first paper, "Ensemble Possibilities and Problems in Computer Music," David Jaffe (CCRMA) dealt with synchronization and phrasing within one or more musical lines performed by musicians. Jaffe proposed a simple yet formal method for describing ensemble interaction by relating score tempo to real tempo. According to Jaffe, this makes it possible to follow and represent modifications during performance. Jaffe's technique for "tempo mapping" can also be used to analyze deformations of a printed score when it is performed.

Roger Dannenberg (Carnegie-Mellon) presented an interactive algorithm for real-time accompaniment of a soloist. His listening model uses a dynamic programming algorithm that has been used in speech research. This algorithm tries to obtain the best correspondence between two sequences of events: the soloist's sequence, recognized and stored, and the score (event sequence). To the computer, the solo is simply a series of detected events. These may be keys struck by a piano, or whatever. The problem then is to find the best match between the two sequences. His paper was followed by a live demonstration on stage. Dannenberg played a trumpet jazz solo (a piece by Miles Davis) accompanied by his system, which he had brought in a small package to Paris. The system was tolerant of some mistakes and irregular tempo changes.

The next two papers dealt with a control system for the 4X synthesizer using a modified flute. Larry Beauregard's presentation demonstrated the control

possibilities and was followed by live flute examples played by Xavier Chabot in an IRCAM studio with a video broadcast in the Espace de Projection. Special procedures to isolate performance parameters to control the 4X were presented. For example, these parameters could be pitch, amplitude, duration, attacks, trills, and so on. The instrumental data was computed in real time and could be stored or dealt with immediately. The sound examples demonstrated control of synthetic FM and additive synthesis instruments on the 4X. In order to achieve reliable results and create a redefinable instrument, the flute had to be equipped with optical sensors on its keys and corresponding cables that might reduce the ease of manipulation and the naturalness of the performance.

Barry Vercoe (M.I.T. Experimental Music Studio) then presented some theoretical and compositional aspects of the flute/4X system. In his presentation, "The Synthetic Performer in the Context of Live Performance," he talked about the control by a flutist of phrasing, temporal shaping, and parameter updating by a real-time synthesized accompaniment. The system Vercoe described consists of the 4X and a DEC PDP-11/55 and uses some programs written by Larry Beauregard. The main role of the system is to listen to the performer in two ways: extraction and analysis of the performer's events by means of an internal score (rhythmic and pitch mistakes are tolerated), and tempo extraction and searches for the current location in the score. The paper was followed by a live demonstration by Xavier Chabot.

All three of these last papers were among the most stimulating moments in the conference, and not just from the scientific point of view; they indicated new possibilities for performance to composers.

Sunday Afternoon: Performance/Demonstration, Reviewed by Goffredo Haus

Synapse for flute and synthetic performer by Barry Vercoe was performed by Larry Beauregard. The demonstration is an artificial intelligence experiment in the interaction between two interpreters (flutist and synthesizer). This interaction is like that between two human performers, chiefly with respect to the rhythmical structures. In other words, the synthetic performer tunes its rhythm as a function of the performance of the flutist. It makes stylistic choices about the interpretation of the score being played. It was spectacular to hear the Beauregard-4X duo. The mutual influence of the performers was clearly recognizable!

Sunday Afternoon: Expressive Control, Reviewed by Sylviane Sapir

Richard Teitelbaum (Berlin) presented "A Digital Piano and Patch Control Language (PCL) System." This system interfaces three Marantz Pianocorder-equipped grand pianos and three microcomputers. PCL was developed by M. Bernard on an MC68000-based computer. It offers possibilities of transformation of musical material via transpositions or recordings that are delayed and reinserted.

D. Collinge (University of Victoria) described "Moxie—A Language for Computer Music Performance." Moxie, written in Forth for a Synclavier I, "is oriented toward the construction of composer-written performance tools." Unfortunately, it was not possible to listen to the results of this work.

A. Luciani and C. Cadoz presented "Instrumental Gesture, Computer, and Retroactive Gesture Transducers," and this was followed immediately by "An Instrumental Simulation-based System for Sound Synthesis in Real Time," by Pierre Lacornerie and Claude Cadoz, all from ACROE-LIFIA in Saint-Martin d'Heres, France. Their research deals with an instrumental approach to musical creation by computer. The videotape showed the TGR (Retroactive Gesture Transducer) that allows the connection of a sensory world (gesture) to the digital/electronic world. The real-time sound synthesizer for the simulation of instrumental mechanisms was developed on a DEC LSI-11 microcomputer and on a dedicated prototype, the CTR-Cordis. This approach is very original and the first results will

probably be followed by interesting developments. However, a system complex enough for composition seems to be difficult, chiefly from a technological and mechanical point of view.

"Specifying Envelopes by Rule," by Chris Chafe (CCRMA), described work implemented on the Samson Box at CCRMA and with FORMES at IRCAM. The envelopes are linear functions that allow the real-time determination of such synthesis parameters as amplitude and frequency, or of such physical parameters as velocity, bow pressure, and string length. Chafe, a cellist, presented several sound examples.

In a completely different field, Robert A. Moog (Big Briar, Inc.), detailed the specifics of the MIDI (Musical Instrument Digital Interface). He concentrated on the continuous transmission of time-varying parameters and discussed applications of the various MIDI message modes. Finally, Moog proposed a scheme for stand-alone instruments.

J. Sundberg's (Royal Institute of Technology, Stockholm) paper broadened the one presented at the 1982 ICMC in Venice, Italy. He looks for rules for musical performance that introduce shadings and modify tempo and phrasing. Sundberg's method consists of first programming the musical score of the melody. The computer then converts the parameters to be sent to a synthesizer and possibly modifies the performance according to three types of rules. Sundberg pointed out that these rules have a close correspondence with rules of spoken communication. Unfortunately the sound examples were excessively simple. It would be interesting to see how Sundberg's work could be applied to the performance of contemporary music.

This long session was ended by M. Clynes (New South Wales State Conservatorium of Music), who presented a paper about "A Composing Program Incorporating Microstructure." Clynes underlined the importance of pulsation, dynamics, vibrato, microrests, and timbral change for the performance and interpretation of musical pieces by synthetic means. A program developed on a DEC PDP-11/73 takes these parameters into account and succeeds in coordinating them via rules given as functions. Clynes played four-voice examples using the music of Bach, Mozart, Monk, and Clynes.

Sunday Afternoon: Concert at Radio France, Reviewed by Nicola Bernardini

The tape music concert of Sunday afternoon was held in a different environment, the Grand Auditorium of Radio France. Three works were presented: *Symphonie Romantique* (second and third movements), by Jacques Lejeune; *Mu Song*, by Richard Karpen; and *Espace et Pleurs*, by Arnaud Petit.

In his composition, Jacques Lejeune has indeed assumed a "musical approach" in a more traditional sense: besides the meaningful title, the work makes large use of sounds taken from the late romantic symphony orchestra. This approach, though not particularly original, has at least allowed the composer to organize the musical structure of his piece in a way that is easier for the listener to relate to. The second movement, subtitled *Romance à claire-voie*, begins with a very light tessitura made of a small galaxy of bell-like sounds, effectively producing the "atmosphere of expectancy" mentioned in the program notes. The dilation of these sounds into larger events allows one to discover male choir sounds and other elements whose spectra were previously hidden by the short envelopes of the percussive elements. The third movement, subtitled *Grand galop à Pandémonium*, is, to some extent, an answer to the rarefied atmosphere of the preceding one. Here, the sounds are very clearly sampled from orchestral strings and brass and manipulated mainly by feedback and regeneration, exploiting the rhythmical structures inherent in these processes. The result is a very lively musical environment, and the contrast between the second and third movements is a clear reminiscence of an adagio followed by an intense scherzo.

Richard Karpen's composition, *Mu Song*, was realized on a DEC PDP-11/44 at the Center for Computer Music at Brooklyn College in late 1983. It is, in some way, the musical setting of a poem by the Chinese poet Mu Mu-T'ien. As the program notes specify, the use of linear predictive coding (LPC) analysis-synthesis, frequency modulation, additive synthesis, and digital reverberation is made throughout the composition. In this sense, this work reflects an attitude towards the integration of verbal

and musical messages that is rapidly growing old after the milestones realized by Charles Dodge and Paul Lansky. The LPC technique, used in conjunction with verbal signs, already has a very strong connotation that weakens its musical interest.

The third work in the program, *Espace et Pleurs*, by Arnaud Petit, is structured on the interaction of two opposite sound fabrics: a streamlike, vaguely repetitive line, made of a quasi-monodic segment interspersed with percussive events (the "*Pleurs*" indicated in the title), and a large, rich mass in which the movement of internal elements reinforces its general stasis (the "*Espace*"). Here too, linear prediction techniques were used to mediate this opposition. Their use was not obvious this time, and the piece was not lacking a certain character.

It is difficult, when listening to these pieces (and, for that matter, to many of the others presented in this year's ICMC), not to indulge in some reflections. First of all, considering the relatively young age of the three composers, one might suppose these works to represent the next generation of computer music starting to take shape. If this is so, the impression is a disappointing one, since this new generation seems to suffer from the same problems of the old one, with the added misfortune that interest in computer music can no longer be based on technological novelty only. Musical content must now come to the fore. To mention a few examples, overestimation of the relationship between length of the pieces and the potential richness of the materials leads one to think that this problem arises from an old conception of development, which now should be thoroughly reconsidered with a new perspective. Other problems, like the choice of materials and the notion of musical coherence, should be reanalyzed to open up new spaces that are truly musical. In short, an increased incisiveness and greater depth is expected from this new generation.

As a conclusion to this review, the incredible *Acousmonium* by Philippe Mion of INA/GRM should be mentioned. The system is composed of (at least) 40 loudspeakers of various shapes and dimensions distributed in the concert hall through which this music was performed. In addition to the excellent quality of the reproduction, the large variety of sound localization possibilities transformed the sounds into virtual physical entities, leaving the absence of visual stimuli almost unnoticed.

Sunday Evening: Concert at Centre Georges Pompidou, Reviewed by Eugenio Giordani

This concert once again affirmed the predominance at this conference of musical thought tied closely to traditional instrumental writing. Richard Hoffman's *String Quartet No. 4* was based on an episode that expands and detunes the instruments' strings, and that served as the formal basis of the work's structure. This detuning represented a sort of shifting of the basic reference system (especially with respect to pitch) supported in all other dimensions. Glissandi and specific points of sound were used alternatingly to clarify the relative motions so created. The materials on tape—characteristic simple FM sounds—seemed foreign to the live music, especially the acoustic density of the former compared to the four strings. Instead, the *concertanti* section for tape solo strongly expressed a sense of automatic rhythm and timbral space of high quality. Tension in the work as a whole was resolved, according to the composer, by the final retuning (the idea of resolution still lives!). The famous A440 Hz was played over the loudspeakers while the four superb performers at last tuned up by hand in the usual fashion.

The second work of the evening, *Profondeurs de Champ* for contrabass clarinet, instrumental ensemble, and tape, by Thierry Lancino, revealed immediately a different and more positive proportional relationship between live performers and tape. The extreme low notes of the contrabass clarinet, exceptionally well played by Harry Sparnaay, established an interesting timbral antiphony to the tape sounds—an overall effect of well-defined, separate dimensions making up a unified whole. The work evolved through episodes of instrumental tension and increasing density, arriving at moments of relaxation without, however, a lessening of energy. The last part suggested a recapitulation with the projection of materials in a more granular dimension (achieved

by the use of high frequencies and microglissandi), supported also by the tape sounds, toward an obsessive final tremolo. The synthesized sounds were of singularly high quality, produced by the 4X system, which is becoming for many composers a favored means of musical expression.

The third work, *3 Asko Pieces*, by Gottfried Michael Koenig, entirely instrumental but written with the aid of a computer, raised once again the issue of algorithmic music. The composer's task is divided in two: first, he must determine his working environment and his decision criteria. Second, he must extract all relevant musical variables and fix them in terms of an explicit program comprehensible to a computer. It was very interesting to note that even at a first hearing, the degree of coordination of "primitive" musical elements (density, reduction, tension, resolution, predictability) emerged in so natural a manner from an automated procedure. Altogether superb work, the *3 Asko Pieces* were splendidly performed and directed (notwithstanding notational difficulties).

In the evening's fourth and final work, Roger Reynolds's *Transfigured Wind III*, for solo flute, 14 instruments, and tape, we again heard the coupling of instrumental writing with electronic sounds on magnetic tape. The digitally-synthesized transformation procedure applied to the flute was effective in almost all the different expressive moments. Contextual consistency was maintained even though the artificial increase of the instrument's expressive possibilities yielded results foreign to the flute's natural sounds. Leonore Pameyer, the flute soloist, confidently handled all the virtuoso and timbral difficulties during the course of the work. These managed to include all possible combinations of flute, instruments, and tape. The solo flute concluded the work, just as it had begun it, as if to confirm the generating element of the entire composition.

Monday Morning: Studio Reports III, Reviewed by Goffredo Haus

The Swiss Center for Computer Music was founded in 1984 by G. Bennett, R. Boesch, A. Greco, and B. Spoerri. It does not depend on any existing institutions and uses two DEC PDP-11/73 computers, a DEC Microvax, and a DMS DMX-1000 audio signal processor. Actually, the Center has two locations, one in Zürich and the other in Geneva. Among its members, Gerald Bennett developed the CHANT program for vocal synthesis, together with Xavier Rodet of IRCAM.

According to Pierre-Alain Jaffrennou, Studio GRAME in Lyons is particularly interested in musician/machine interaction for performance. They have developed a microcomputer-based system for gestural control of 16–64 parameters through voltage control. Yann Orlarey of GRAME described his work on Logo Musical, an extension of the language Logo for music education purposes.

Lucasfilm presented a videotape on their workbench for digital sound editing. This consists of an ASP (Audio Signal Processor) and a cue sheet editor. Viewing the video, it was possible to appreciate the efficient interaction techniques and also be entertained by their research on film sound effects.

Monday Morning: Composition and Research Tools, Reviewed by Daniele Torresan

Kaija Saariaho began by describing her compositional research. Her main goal is a hierarchical interrelationship among all the parameters of the sound. The rhythmical and timbral examples were very interesting and presented three types of musical transformation of sound events: gradual transition and interpolation, sudden change, and superimposition. These same three basic operations were also applied to timbral composition through formant filtering and through insertion of white noise in certain points of the spectral evolution. All the examples used the FORMES language.

Alain Savouret (INA/GRM) in his paper, "Sound Mutation and Musical Operation," talked about the possibilities that are offered by different kinds of digital signal processing of everyday sounds. He presented sound examples from his composition, *Don Quixote* (1981).

Monday Morning: Signal Processing II, Reviewed by Giovanni De Poli

A common factor of all the papers in this session was that the analysis of natural sounds has an important role, either to produce useful parameters for synthesis or for score transcription. The first paper, "Synthesis of Consonants in Singing," by J. Zera, J. Gauffin, and J. Sundberg (Stockholm), briefly skimmed through the problems of sung vocal synthesis. Sundberg then illustrated the MUSSE analog formant synthesizer, which has two pole-zero circuits, two noise generators, and a high-pass filter. The synthesizer is driven by a control computer. The tests made dealt with the Italian names of the seven musical notes (do-re-mi, etc.). Using data taken from the literature and from their own analysis, they were able to obtain convincing melodies sung by a synthetic bass. The demonstration, which also had some graphs of the main characteristics impressed the audience very much. We wait with great interest for the completion of this work on the rest of the consonants.

Mark Dolson (CARL) presented his paper "Refinements in Phase-Vocoder-based Modification of Musical Sounds." After discussing some improvements to previous implementations, he talked about applications, among them noise reduction of recordings. This is achieved by pruning the output of some of the analysis filters according to well-chosen criteria. However, we still heard a click in the middle of a note.

The next paper, by K. Kashima and A. J. Rockmore (CCRMA), "Acoustic Processing Methods for Musical Sounds Based on a Recursive Constant-Q Transform," described a system for the analysis of the partials in a piece of polyphonic music. Their goal is to extract the fundamental note and therefore capture the score for automatic transcription. A high temporal and frequency resolution is needed, especially for low frequencies. This Constant-Q algorithm has a constant resolution for each octave. Kashima finished his paper early, and this left time for a long discussion of goal-driven sound analysis, with the participation of the audience.

The last paper of this session, "Sound-Structuring Techniques Utilizing Parameters Derived from a Vocal Analysis System," was presented by G. A. Mian and G. Tisato (CSC, Padua). They described a system that can be seen as a sophisticated editor that allows the generation of vocal parameters and prosodic rules from a written text, and the extraction of these parameters through analysis. Various representations and different synthesis techniques can be controlled by these parameters. The paper was accompanied by sound examples that Tisato unfortunately did not have time to play. The arrival at IRCAM of the French Minister of Culture and other officials imposed a rapid conclusion to this talk.

Monday Afternoon: Panel on Instruments, Interfaces, and Networks, including MIDI, with the participation of Robert Moog, Antonio Bosetto, William Buxton, Emmanuel Favreau, Katsuhiko Hirano, George Lewis, and Gareth Loy, Reviewed by Maurizio Rubbazer and Curtis Roads

For the first time, the Musical Instrument Digital Interface (MIDI) was highlighted through an ICMC panel (Fig. 8). MIDI is a software and hardware standard for interconnecting computers and synthesizers via special cables. The devices can communicate with each other by sending MIDI messages, which are byte-size codes that convey musical information such as "play a note," "change voice," and so on.

The MIDI panel gave panelists and conference-goers an opportunity to provide critical feedback to the music instrument industry. The panelists began with an examination of the hardware and software characteristics of MIDI, together with the advantages and drawbacks of the system. Some, like George Lewis (Fig. 9) played examples realized using MIDI to interconnect several synthesizers with a small computer. In Lewis's case, this was an Apple Macintosh and several Yamaha DX7 synthesizers.

It was clear from the discussion that MIDI is not well suited for general musical research in computer music. This is due to the limited trans-

Fig. 8. MIDI panel. From left, Antonio Bosetto, George Lewis, Robert Moog, Gareth Loy, William Buxton, Katsuhiko Hirano, and Emmanuel Favreau. (Photograph by Patte Wood.)

mission speed, the impossibility of nontempered pitches, the lack of timbral information, and minor incompatibilities between different manufacturer's implementations of the standard.

MIDI was not intended as an interface to control any synthesizer, analog or digital. Rather, it was conceived by a group of companies as a way to control their synthesizers in certain ways and to expand them through keyboards, sequencers, and personal computers. Within specific limitations, MIDI works fairly well, even though it is not an ideal solution. For instance, musicians complain about transmission delays that are data-dependent, the complexity of cabling, and the limitations in the lengths of the interconnections. On the other hand, MIDI has the undeniable advantage of being a standard. This allows the musician to interface a new instrument without spending weeks on the problem.

After debating the advantages and disadvantages of the system, the consensus among the panelists was that MIDI should not be modified at the present time. As Gareth Loy (CARL) intimated, we are lucky to have any kind of standard. It is not clear if manufacturers will ever agree to an extension to or a replacement of MIDI. Instead, various compatible extensions were suggested by panelists. One scheme, proposed by William Buxton (Toronto), involves the use of several inexpensive MIDI controllers attached via an Ethernet to a host computer. Each of the MIDI controllers handles a separate MIDI line, which attaches to a single MIDI device.

Monday Afternoon: Affordable Systems, Reviewed by Andrea Libretti

The first paper, "Voicing the DX7," by David Bristow (Bedfordshire, U.K.), was a live demonstration of the possibilities of control between a Yamaha DX7 digital synthesizer and a Yamaha CX5 music computer (Fig. 10). The most impressive point of the demonstration was the timbral quality of the DX7 in relation to its cost (under $1600). Bristow showed that timbre editing via computer can greatly increase the simplicity and usefulness of such a synthesizer.

Yamaha has produced the YRM-103 program (a voice-editing program) to allow musicians to tune the parameters of special algorithms, envelopes, and synthesis operators (oscillators) of the DX7. The program uses color graphics to display histograms of all the parameters, and graphical plots of the waveforms and envelopes. The Yamaha Music Macro program is another software package that allows compositional control of the FM oscillators of the

Fig. 9. George Lewis at the MIDI panel. (Photograph by Patte Wood.)

Fig. 10. David Bristow (left) at the very popular Yamaha demonstration table. (Photograph by Patte Wood.)

DX7 and CX5 within the context of the Basic language. A total cost of less than $2000 for both the CX5 and DX7 seems reasonable for every small research and educational center.

Daniel Arfib (LMA, Marseille) presented two papers, "An Educational System for Assisting Composition" and "Will the Small Fry Swallow the Big Fish?" Arfib first talked about an educational system made of an Apple II computer, a Yamaha DX7 and a Koala pad, linked via MIDI. The system reads and writes MIDI files and allows interaction via graphics and a clavier.

As another example of small systems taking over the functionality of large systems, Arfib described an interesting software package for the Texas Instruments TMS 320 signal processing chip that translates Music V statements into TMS 320 microcode. All this was ironically compared against the cost of much larger systems that perform essentially the same tasks. He also showed many slides and played interesting sound examples.

Kenneth Newby (Vancouver) presented another system based on a Yamaha DX7 controlled via MIDI by a Commodore 64 microcomputer. The author has developed compositional software in Forth, taken from research on process automation (Chadabe) and stochastic grammars (Bolognesi/Jones/Truax). The system can also take in control signals from external sources for use in performance. The sound examples confirmed the validity of such an approach and demonstrated the quality of the system at a low price.

The last paper of the day, "An Intelligent Ear-training Lesson," by Dorothy Gross (Minneapolis), dealt with the results of a series of music lessons at the University of Minnesota using a computer-aided instruction (CAI) system. The system consists of an Apple II computer with the ALF (square wave) synthesis board. Gross claimed that good results were achieved in the recognition of small groups of chords or intervals. However, for larger structures such as melodies less satisfactory results were obtained. With this system, non-piano-playing students can study musical progressions much more easily. Unfortunately, some students found it more difficult to recognize the synthetic progressions played on the ALF board than the piano progressions. The harmonic structure of the sound is important for pitch recognition, she concluded.

Monday Early Evening: Concert at Radio France, Reviewed by Nicola Sani

The IRCAM/ICMC concerts were not particularly satisfying. It would be incorrect to speak in terms of computer music since the works played were not precisely computer music works. Nor is it easy to understand why so many composers use advanced technologies to perform old-fashioned music. The problem as one can imagine, is both cultural and political, the latter factor related to the way in which musical institutions are organized these days. What really emerged from IRCAM/ICMC was the need to specify new dimensions for the development of musical languages in order to avoid the risk of a sort of cultural exhaustion.

Most of the composers presented in these concerts used the computer to imitate traditional acoustic instruments in character, timbre, and particularly in the articulation of neoromantic and/or postserial expressive forms—an alarming state of affairs to my ears. After over twenty years of research it seems reasonable to expect more advanced results, particularly regarding language and musical thought. To be clear, these observations do not refer to musicians such as Risset, Höller, Dashow, Saariaho, Truax, and Murail. Unfortunately these remarks do refer to the majority of pieces heard in the evening concerts. I was unable to hear many of the pieces played during the afternoon concerts since they were played simultaneously with the scientific sessions. The separation of tape music in the afternoon from instrumental music in the evening was not a very happy situation, to say the least.

The 6:30 P.M. Monday concert was held at Radio France's Grand Auditorium and included a program of pieces by André Bon, Marc Battier, Alan Schindler, and Alejandro Vinao performed by the Ensemble 2e2m conducted by Paul Mefano, with the participation of Sylvie Beltrando and Brigitte Sylvestre, harps; Daniel Kientzy, saxophone; Philippe Muller, cello; and members of the English ensemble Option Band (Kathryn Lucas, flute; Rohand de Saran, cello; and Martine Jeanneret, piano).

André Bon's *Fragments* for saxophone, two amplified harps, and the Quatron digital synthesizer was commissioned by the French Minister of Culture and realized at LIMCA (Lutherie Informatique et Musique Contemporaine à Auch). The Quatron is a system designed and realized by Philippe Prevot for the real-time performance of musical scores. The parameters processed by the Quatron are separated into *value* parameters (like amplitude and time) and *determination* parameters (like score modules, timbres, and control modes). The realization of this machine is an important step in the process of integration between musical research and live performance. *Fragments* was characterized by the highly visible presence of live action, the most notable aspect of the work, which seems to have been included for the sake of show and performance implications. Unfortunately, the persistent dominance of the melody and the too-often extemporary use of the synthesizer deprived the composition of interest. The saxophone (well played by Daniel Kientzy), with Coltrane-like modal progressions, only served to recall once again a by-now-very-common jazz influence. Solid performances were turned in by harpists Sylvie Beltrando and Brigitte Sylvestre and by Prevot, who handled the electronic realization.

Marc Battier's *Encre sur Polyester* is a five-part composition for wind quintet and tape, realized at IRCAM. The electronic parts consisted of acoustic instrumental sounds processed by the 4X, which was simultaneously the source for additive synthesis sounds. Specific rules based on signal analysis (spectral content, envelope following, etc.) controlled the 4X processing. "Magnetic tape and instrumental ensemble behave as a form and its reflex," according to Battier in the program notes. However, it seemed that the electronic part was too much influenced by the instrumental timbres and the results were too predictable. Among the five parts, the last one, stretched and enlarged, seemed the most successful. Certainly the most interesting aspect of the work was the acoustic result of the performance due to the exceptional sound-distribution system in the Radio France Auditorium, realized by the INA/GRM group.

Allan Schindler's *Tremor of Night and Day* was probably the most disappointing work on the program. The piece, conceived for cello and tape, was realized at the Eastman School of Music where Schindler directs the Eastman Computer and Elec-

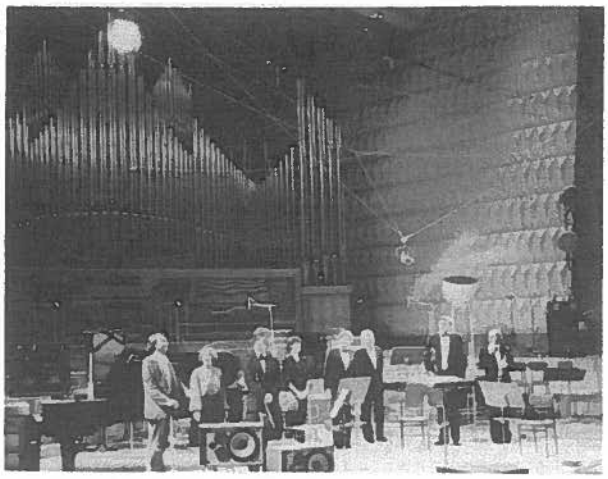


Fig. 11. Conclusion of Jean-Claude Risset's Profils *at the Auditorium of Radio France. (Photograph by Patte Wood.)*

tronic Music Center and teaches as professor of composition. The computer-synthesized tracks simulate a vocal style, while the cello moves between stylistically familiar melodic lines that could be described as sometimes romantic and sometimes postdodecaphonic. Here in Schindler's work one can clearly recognize the problem of the regressive trends in contemporary music. It is my feeling that music today cannot be composed as it was a hundred years ago, as if nothing has happened in the meantime.

A stronger structure was evident in Alejandro Vinao's *Triple Concerto*, performed by members of the Option Band—an English ensemble which investigates the spaces in and between electronic music and multimedia. The tape was realized on a Fairlight CMI at the Electroacoustic Music Studios of the City University of London. Vinao processed acoustic instrumental sounds with the Fairlight. This instrument seems to have forced the composer to emphasize the work's melodic structure in such a way as to make too obvious the dialogue between the tape and the live instruments. Certainly using instruments like the Fairlight in serious music poses problems that can be difficult to resolve largely because of the fundamentally commercial music purposes for which these instruments were designed.

Monday Evening: Concert at Radio France, Reviewed by Richard Karpen

The late evening concert at Radio France consisted of pieces by Denis Dufour, Tracy Peterson, Jean-Claude Risset, and Marco Stroppa. Dufour's *Pli de perversion n. 2* (1984), for string instrument, synthesizer, and a digital processor called Syter began the concert. Unlike many of the pieces for instruments and tape and/or live electronics played at the conference, the digital processor's role in this composition was a major part of the piece and was well integrated with the nonelectronic instrument. The highpoint of *Pli de perversion* was the real-time echoing and spatial distribution of the violinist's pizzicati.

Digital Tantra II (1984) by Peterson for tape alone had two main musical ideas. The first was an exposition of lyrical melodic material using synthetic vocal sounds. This was followed by the second idea that contrasted with the first by its "spliced-up" quality, which reminded one of early electroacoustic music. The remainder of the piece consisted of a synthesis of the two ideas or qualities. This synthesis gave Peterson's piece a simple but at least comprehensible shape and clear musical message.

Jean-Claude Risset's *Profils* for seven instruments and tape had the delicate refined quality of much of Risset's music (Fig. 11). The relationship between the live instruments and the sounds on tape was one of similarity. This made the dialogue between the two very subtle, perhaps a bit too much so, but gave the piece a strong singular identity.

The concert ended with two extracts from Marco Stroppa's as yet unfinished cycle, *Traiettoria*, "Traiettoria . . . deviata" and "Dialoghi," for piano and tape. The virtuosic piano part was admirably executed by Adriano Ambrosini. The tape, which was made at the Centro di Sonologia Computazionale, Padova, using Music V and ICMS, was usually in conflict with the piano, although in "Dialoghi" the combined aural image of the two created some fine moments. The not-always-successful integration of the piano with the tape into a common style and structure may have been due to the composer's

striving for an equilibrium between an older technology (the piano) with the musical styles it encourages and the contemporary technology. This is a difficult task and an area in which it is hoped the debate will continue.

Tuesday Morning: Studio Reports IV, Reviewed by Goffredo Haus

Tristram Cary (Elder Conservatorium of Music, Adelaide) began the session. He works on a Synclavier I and uses three personal compositional programs. Cary believes that each new composition needs special-purpose software.

J. Gerbrich (Brno) presented an overview of "Computer Music Compositions in Czechoslovakia." He detailed R. Ruzicka's work. Ruzicka, based at the Janáček Academy of Music in Brno, has written about 30 algorithmic computer music compositions since 1965. Gerbrich presented two excerpts taken from Ruzicka's *Discordia* and *Sinfonia-Concerto* for violin and orchestra.

The computer music studio at Northwestern University in Evanston developed a software package SCHED that runs under Unix and uses a Yamaha DX7 as the audio output. The system has a library of software digital instruments that are executed simultaneously as independent Unix processes. INSLIB generates Music 4BF-like instrument code. PSCALE is a filter that translates timbral descriptions into synthesis parameters. ELED is a list editor for musical events.

Tuesday Morning: Signal Processing III, Reviewed by Giovanni De Poli

"Research on Morphological Similarities in Sound Signals Originated from Instrumental Sounds," by Avio, Giordiani, Gabrielli, and Danti (Ancona), dealt with a database available at ISELQUI in Ancona. The institute ISELQUI works in conjunction with many electronic music instrument manufacturers. The ISELQUI database contains sound analysis data of musical instruments. ISELQUI has also developed an interactive system that allows researchers to edit, analyze, extract, and reduce synthesis parameters from the analysis database.

"Frequency Dependent Waveshaping," by Giovanni De Poli (CSC, Padua), is a simple computational extension of traditional waveshaping. The output signal is obtained by a sum of several polynomial waveshapings, applied to subsequent delayed values of the input sinusoid. A few simple examples showed that it is convenient to use nonlinear network techniques for an effective sound synthesis.

"The Allpass Approach to Digital Phasing and Flanging," by Julius O. Smith (CCRMA, Stanford), pointed out the difference between flangers and phasers. The author described how notch (allpass) filters can be used to obtain these audio effects. He presented his system in detail and discussed the choice of various parameters, while offering sound examples that demonstrated his points.

"Spatial Reverberation—Simulating the Spatial Cues of Real Environments" and "The Role of Spectra Clues in Sound Localization with Speakers" were presented by Gary Kendall and William Martens. In agreement with their subject, they delivered their talk "in stereo"—from two different spatial locations. They showed how listening is different for each person, providing an amusing nineteenth-century drawing of many different people, the entire image shaped in the form of an ear. They then detailed the technical and implementation aspects of a model of reverberation that allows one to localize the reverberated sound.

Tuesday Morning: Composition and Research III, Reviewed by Daniele Torresan

Claude Cadoz and A. Luciani (ACROE-LIFIA) presented "Processes, Sound Synthesis Models, and a Computer Designed for Musical Creation." They pointed out how musician/machine interaction has to take into account all phases of music compositional process: gestural/visual action in real time, acoustic/perception-based synthesis models, and the organization of structural processes.

Phillipe Manoury (IRCAM) expounded on "Natural and Artificial Compositional Processes." According to Manoury, his research not only takes

into account perceptual models, but also more complex compositional processes like those of J. S. Bach, as well as Renaissance polyphony and Gregorian chant.

"A Demonstration of FORMES in Its Use for Driving Synthesizers in Music Research and Production" was a video production staged by X. Rodet, P. Cointe, J.-P. Barrière, Y. Potard, B. Serpette, and J.-P. Briot. Their system FORMES makes it possible to explore a previously unknown sound world. According to Rodet, FORMES goes beyond the use of the voice and musical instruments. FORMES uses sound archives that contain rules and data that can be easily manipulated. In this presentation, Rodet was on stage, typing at a terminal and controlling real-time synthesis with FORMES and the IRCAM 4X.

Tuesday Afternoon: Computer Music Association Meeting, Reviewed by Curtis Roads

The Computer Music Association (CMA) was founded in 1979. The main goals of the CMA are to provide international computer music conferences and to support interchange of information about computer music.

The annual CMA meeting, besides being a legal necessity, serves an important function to the computer music community. A scheduled CMA meeting ensures that time is set aside for these communications: announcing the next conference, soliciting proposals for future conferences, discussing the delivery of CMA services to members, informing members of the CMA financial picture, reporting on the status of *Computer Music Journal*, and more generally, gathering feedback from all in attendance through an open forum.

This year a major reorganization of CMA services was announced by William Buxton (Toronto), president of the CMA. The quarterly *Newsletter* has been revamped and the mailing system has been improved. Craig Harris (Rochester) has taken on the task of handling orders for publications. Publications orders, formerly backlogged, are now up to date thanks to Harris's efforts. The CMA finances are in good shape, with a healthy surplus.

Perhaps the most significant change introduced by President Buxton concerned the conference proceedings. In the past, the CMA has arranged for the proceedings of a given conference to be compiled and distributed after the conference. Starting with the 1985 ICMC in Vancouver, the proceedings will be distributed to each participant at the conference.

Tuesday Afternoon: Signal Processing IV, Reviewed by Giovanni De Poli

"Programming the 4X," by P. Potacsek, E. Favreau, and A. Gerzso (IRCAM), presented the current software for the 4X digital signal processor. This software consists of an orchestra language, an assembler, and an optimizer. The optimizer determines which instructions can be executed in parallel and allows a full exploitation of the pipeline structure of the machine. From the paper it seemed as if the authors have developed an environment that a musician would find easy to use, and without technical overload.

"Application of Digital Signal Processing to Musical Composition/Algorithms and Realization on the UPIC," by M. Rozenberg (Paris), described the UPIC synthesizer at Iannis Xenakis's CEMAMu with its graphics interfaces. One of Xenakis's students talked about a method to modify wavetables taken from the theory of image processing. For example, through image transformations it is possible to remove spikes from a wavetable. As in the tradition of CEMAMu, everything is processed in the time domain and not in the frequency domain.

Two papers, "A Functional Overview of the Compusonics DSP-2000 Series" and "Musical Recording, Editing, and Production Using the Compusonics DSP-2000," by J. P. Sautner, D. Schwartz, and G. Schwede (Compusonics, Cambridge, Massachusetts), illustrated the objectives of the DSP-2000 audio mixer with a series of excellent slides. This all-digital mixer is intended as a high-quality tool for sound recording, editing, processing, and playback. After mentioning specification and solutions to technical problems, they discussed the available software for sound editing.

Fig. 12. Marco Stroppa. (Photograph by Patte Wood.)

"A Gate-Array ASP Implementation," by James A. Moorer, was presented by John Snell (Lucasfilm). He described the characteristics of the new TTL implementation of the ASP. This version is mostly software compatible with the ECL prototype (described in *Computer Music Journal* 6[3]:22–32). In order to achieve the necessary high speed, they had to design semicustom gate-array chips for the most time-critical sections of the device. In particular, they produced two kinds of gate arrays for the multiply-shift-accumulator. As a result the TTL machine has a macroinstruction time of 65 nsec, which is close to the 50 nsec time of the larger and more costly ECL version.

Tuesday Afternoon: Composition and Research IV, Reviewed by Daniele Torresan

"Research and Musical Tools—Experience in a Non-Real-Time Studio at INA/GRM," by B. Maillard and Y. Geslin, summarized the experience of the production studio at INA/GRM from 1979 to 1983. They described activities oriented toward a comprehensive examination of sound. Over the years, Maillard and Geslin have provided technical support for about 30 composers that were not necessarily computer-literate. Finally, they examined the advantages and the drawbacks of non-real-time compositional practice.

"On the Automatic Transcription of Percussive Music: Recent Progress," by Andrew Schloss (CCRMA), demonstrated a method for musical analysis and transcription based on three levels of analysis: micro, meso, and macro. After the technical explanation, Schloss played a series of examples of techniques for the recognition of attacks in percussive music.

In the third paper, "Operations on Timbre—Perspectives and Problems," A. Wayne Slawson (Pittsburgh) explained how it is possible to define a timbral space that takes into account the "color" of the sound. Slawson defined color by means of a list of dimensions: openness, acuteness, smallness, and laxness. He identified equal-contour lines for each of the dimensions that were applied as an example to the spectral envelopes of vowels. According to Slawson, this theory can also be applied to different synthesis models and parameters. However, several members of the audience objected to Slawson's presentation on the grounds that he did not consider musical pitch in his research.

Barry Truax (Simon Fraser University) supported the effectiveness of interactive sound synthesis to explore and optimize musical processes. According to him, digital signal processors such as the Digital Music Systems DMX-1000 allow a composer to deal with large sound archives and to make real-time modifications in order to expand the palette of potential sounds.

Marco Stroppa (M.I.T.) stated in advance that his paper was musical and aimed to describe the com-

position of his piece *Traiettoria* for piano and computer-generated sounds (Fig. 12). He demonstrated the high level of interaction between a musical instrument (the piano) and computer-generated sounds. The sounds heard at the Monday evening concert demonstrated the quality that is obtainable with wise use of Music V and of a good editing system like ICMS by G. Tisato at the CSC, Padua.

"The 1948 Sackbut-Performance Mode of Electronic Instruments," by Gayle Young (Grimsby, Ontario), described an electromechanical instrument built between 1945 and 1948 by Hugh LeCaine. Young's presentation was a highly interesting discovery to many in the audience, because of the amazing construction of the LeCaine instrument and the quality of the sound examples. The Sackbut hardware was mainly wood, and had efficient electromechanical systems that transduced the performance gestures. It allowed control of the attack, the envelope, and the pitch deviation in fluid and expressive ways. In the question and answer period, one member of the audience said this was the most interesting presentation at the conference.

Tuesday Early Evening: Concert at Centre Georges Pompidou, Reviewed by Mauro Graziani

Only two pieces were heard in this concert at the Petite Salle of the Centre Pompidou. The first composition, with the unlikely title of *Çoğluotobüsişletmesi* (to be abbreviated herein as *Co*), was presented in no less than two versions: the first for computer solo; the second for unaccompanied piano, two hands. Of the two pieces, *Co* was certainly the more captivating. This listener found himself completely surrounded by a continuously pulsating sonorous flux, suggestive of a somewhat oriental, if not to say exotic, feeling, which could be traced to Calcutta, birthplace of the composer, Clarence Barlow. Beyond this, *Co* is the work rife with complexities. It is based on an experiment that centers principally around tonality and regularly metrical rhythms.

In my view, the underlying experimentation was perceivable only in the version for computer. The computer was able to perform the work completely and with the precision desired by its composer; instead, the version for piano considerably obscured this highly significant aspect of the piece, notwithstanding the indubitable technical ability of pianist Herbert Henck. The piano performance left a fragmentary impression, less enjoyable than the earlier version, due in large part, no doubt, to the fact that the pianist, possessing only 10 fingers rather than the prescribed 16, was compelled at times to perform acrobatic feats that hindered the simultaneous perception of the various strata that make up the composition.

Thomas Kessler's *Flute Control* was an altogether different piece. Here a flute performed by Aurèle Nicolet piloted some electronic gear (a Fairlight CMI IIX and VT-5) that analyzed pitch dynamics and timbre of the acoustic instrument. The main interest in this piece was the sort of electronic audio halo that surrounded the flute sounds. The work's structure, however, suffered from a lack of vertical textures, a defect typical of monophonic instruments (although for some time now, digital instruments have offered the means for overcoming this problem). The overall sound of the piece so often suggested the classic ring modulator that one could not avoid a sense of "*déjà-entendue*" tied to methods and problems having little or nothing to do, in conception, with digital instruments. The piece was certainly experimental indeed, considering the obvious limitations of a single Fairlight used as a real-time processor. Upon our exit from the Petit Salle, a cold wind was sweeping through Paris, and through us swept the chill of the approaching evening concert.

Tuesday Evening: Concert at Centre Georges Pompidou, Reviewed by Nicola Sani

The final concert of the 1984 ICMC, held in the Grande Salle of the Centre Pompidou, was performed by the Ensemble InterContemporaine conducted by Michel Swierczewski. The concert included works by Tristan Murail, Nigel Osborne, Luis De Pablo, and York Höller.

Murail's *Desintégrations* for orchestra and tape, commissioned by Mme. Weill for IRCAM, was the result of a thorough study of the notion of spectrum. Murail's work with timbre is characteristic of his music as a whole, and reflects his activity with the group Itineraire. Here Murail succeeded in casting his studies into a solid compositional coherence that features a tension inside his sounds that continually renews itself. The tape was realized with IRCAM's 4X. Spectrum-processing rules were concerned with fractionization—using only one portion of a particular spectrum—and creation of inharmonic spectra—linearly with additive or subtractive synthesis, nonlinearly by means of spectral distortion. A wide range of spectra were generated largely through additive synthesis, while the work itself consisted of eleven connected sections, each of which accented some aspect of the spectrum-processing rules.

Less interesting was Nigel Osborne's *Alba* for mezzo-soprano, orchestra, and tape, commissioned once again by Mme. Weill. The work would have been essentially monotonous were it not for the shining performance of mezzo Elizabeth Lawrence. The words were drawn from four poems by S. Beckett written in 1944, *Saint-Lo*. Sadly, neither the text nor the poetical image of lovers' separation at the white light of daybreak were sufficient to raise the composition's value.

Nor did De Pablo's *Tornasol* exactly sparkle for its originality. The work was conceived for orchestra and tape, commissioned for IRCAM this time by Mme. Rochas. Sounding "pointillistic" and post-serial, the computer seemed forced into the composition, its contribution being not much more than the imitation of a traditional instrument during the course of the piece.

A different evaluation must be made of German composer York Höller's *Résonance*. Commissioned for IRCAM, this time by the Centre Pompidou, *Résonance* was written for chamber orchestra and tape, digitally generated at IRCAM. The central point of the work was the comparison between a real and an imaginary orchestra. The title refers particularly to the musical relationship between these two aspects. Höller's purposes are essentially twofold: (1) to realize the transition from one timbre to another without interruption, as in linear interpolation, so as to obtain a timbral continuum; (2) to start from instrumental spectra and form a system with different or derived timbral structures, as in extrapolation. The compositional structure is based on a sounding figure of thirty-four rounds, divided into five parts. *Résonance*, for score organization, coherent use of technology, timbral range, and dynamic mass was one of the most interesting works presented at the 1984 ICMC.

Satellite Activities

Several "satellite" activities were organized around the conference proper. On Wednesday, Donald Byrd (Kurzweil Music Systems, Boston) convened a session in the Espace de Projection on music printing by computer. A panel on "Computers and Musicology" was also held at the Centre de Recherches Pluridisciplinaires in Paris.

In addition to organizing the ICMC, David Wessel put together an "Off Festival" after the conference devoted to computers and improvisation. This took place at the performance space *28, rue Dunois*, in an informal club atmosphere. The Off Festival was partly designed to balance the formal atmosphere and stylized music programmed by the Artistic Committee of the conference. This festival featured George Lewis, Morton Subotnick, Bill Buxton, Donald Buchla, David Rosenboom, Chris Chafe, David Jaffe, Phillipe Gautron, Andre Hodeir, and Wessel—appearing in the role of performer.