

## Real-time computer music at IRCAM

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Real-time applications have always been an important dimension of and integral to the basic philosophy of computer music at IRCAM. At present, there is a great deal of activity in this domain in the areas of hardware, software, and musical production. A project is underway to develop a new real-time workstation to replace the 4X. The workstation group hopes to develop a powerful portable system which will be easy for musicians to use on an intuitive level. Probably the most important question concerning real-time computer music is the interface between musician and machine. Some of the most interesting software to be written at IRCAM, Miller Puckette's *Patcher*, is a real-time object-oriented, graphics based, musical programming language in which objects send and receive messages. IRCAM supports approximately a dozen musical productions each year. Of these, about 60% involve the computer in real-time concert situations. A list of all works created at IRCAM using electronics in real-time is included.

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Real-time applications have always been an important dimension of and integral to the basic philosophy of computer music at IRCAM. At present, there is a great deal of activity in this domain in the areas of hardware, software, and musical production.

In spite of its age, the 4X machine remains one of the more powerful real-time digital signal processors in the field of computer music. Because of well-developed software, it still gets a great deal of use at IRCAM, enabling composers to realize their musical ideas with flexibility in real-time.

Presently, there is a project underway to develop a new real-time workstation to replace the 4X. The workstation group hopes to develop a powerful portable system which will be easy for musicians to use on an intuitive level. The project is led by Eric Lindemann, who worked for Wave Frame before coming to IRCAM, and includes among its 10 engineers: Gerhard Eckel, Miller Puckette, and Bennet Smith. The prototype for this workstation should be ready in 3 to 5 months. The system uses a NeXT micro-computer as host and the DSP (digital signal processor) is organized around the Intel i860 processor. The DSP board was designed at IRCAM and will be commercially produced by a company in the USA. The workstation group has given a live demonstration of the prototype at the International Computer Music Conference of 1990, in Glasgow.

Another real-time workstation was recently developed (1987-88) by Gerhard Eckel and Xavier Rodet using commercially available hardware based on a SUN-III micro-computer and a Mercury Zip floating-point array processor. Control software was written in *PreForm*, an object-oriented real-time control and graphics toolbox implemented in *Le Lisp* and written by Lee Boynton. Numerous composers have already started to make use of this workstation although it is mainly used for real-time studio work since it is not meant to be a portable system.

Some of the most interesting software to be written at IRCAM in some time (at least since Boynton's *PreForm*) is Miller Puckette's *Patcher*. *Patcher* is a real-time, object-oriented, graphics-based, musical programming language in which objects send and receive messages. Among its features are a MIDI driver, approximately 15 MIDI-oriented objects (including a score follower and various types of sequencers), and approximately 40 other objects useful in any real-time programming environment. *Patcher* runs on Apple computers and is used to control commercial MIDI gear as well as machines developed at IRCAM – including the 4X, the MIDI-flute, and the Matrix system for sound distribution and spatialization. One of *Patcher*'s most salient features is the fact that musical applications can be developed extremely rapidly and composers find it easy to use. A recent application of *Patcher* was developed by Cort Lippe to control real-time spacialization of amplified acoustic instruments via MIDI equipment for a performance of one of his compositions. *Patcher* will be commercialized this summer, and at this time Puckette is working on a version of *Patcher* for the new workstation which will handle audio signals as well as MIDI.

Probably the most important question concerning real-time computer music is the interface between musician and machine. David Wessel (who was at IRCAM for ten years before recently leaving to collaborate in the development of a computer music facility at the University of California, Berkeley) worked with David Bristow, presently of Yamaha, London, and Zack Settel, of IRCAM, on this problem. Settel has continued to explore the idea of expressive interfaces in some of his recent compositions, and has developed tools which enable the detection of parameters within a MIDI environment via acoutical signals using envelope following and threshold detection. This allows composers to use more sophisticated controls than just pedals or switches for instruments without MIDI interfaces.

IRCAM has developed a MIDI-flute using a real flute and a fingering detection system and at present, research on a similar system for the clarinet is taking place. The engineer John Kitamura is working on a pitch-detection algorithm and has developed a MIDI interface for the real-time spatialization system of IRCAM which is used in concerts.

In the field of psychoacoustics, Stephen McAdams is collaborating on a project with Eric Clarke, Henkjan Honing, and Peter Desain of City University, London and the Utrecht Academy of Arts. This research makes use of real-time performances by musicians – used as data to study the question of expressive timing in musical performance.

IRCAM supports approximately a dozen musical productions each year. Of these, about 60% involve the computer in real-time concert situations. The following is a list of real-time productions in progress for the season 1990–91:

- P. Boulez MIDI-flute, matrix spatialization system, and 4X
- D. Cohen MIDI-piano and 4X
- J. Dillon ensemble, tape, matrix spatialization system, and MIDI equipment
- P. Manoury MIDI-percussion and 4X
- I. Nodaira MIDI-piano, MIDI equipment, and 4X
- A. Vinao ensemble and MIDI equipment

A list of all works created at IRCAM using electronics in real-time is included below.

### **Ircam productions with live electronics**

Jean-Baptiste Barrière

*Epigénèse*, pour ensemble de chambre, bande réalisée par ordinateur et 4 × "live" (1986).

Assistant musical: Pierre-François Baisnée.

George Benjamin

*Antara*, pour ensemble et 4 × "live" (1987).

Assistants musicaux: Thierry Lancino et Cort Lippe.

Commande de l'IRCAM.

Luciano Berio

*Chemins D*, pour clarinette et filtre numérique programmé (1980).

Commande de l'IRCAM.

Pierre Boulez

*Répons*, pour ensemble, solistes, 4 × "live" et dispositif de spatialization (1981–87).

Assistant musical: Andrew Gerzso.

Commande du Südwestfunk Baden-Baden.

Marc-André Dalbavie

*Diadèmes*, pour alto solo, ensemble et électronique "live" (1986).

Commande de l'Ensemble Itinéraire.

Philippe Durville

*Miroir du double*, pour ensemble et électronique "live" (1986).

Commande de l'IRCAM.

Lorenzo Ferrero

*Ombres*, pour ensemble et électronique "live" (1984).

Assistant musical: György Kurtag.

Commande de l'IRCAM.

Stanley Haynes

*Pyramid, prisms*, pour piano, bande réalisée par ordinateur et électronique "live" (1977).

Philippe Hurel

*Fragment de lune*, pour ensemble et électronique "live" (1986).

Commande de l'IRCAM.

Michael Jarrell

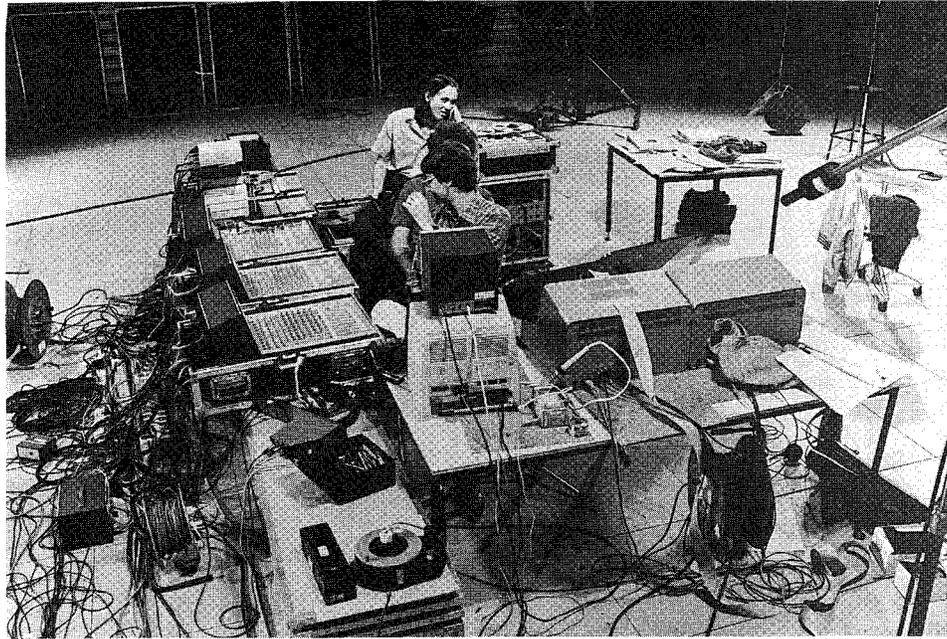


Figure 1 Equipment controlling the 4X computer in L'espace de Projection, IRCAM, Paris

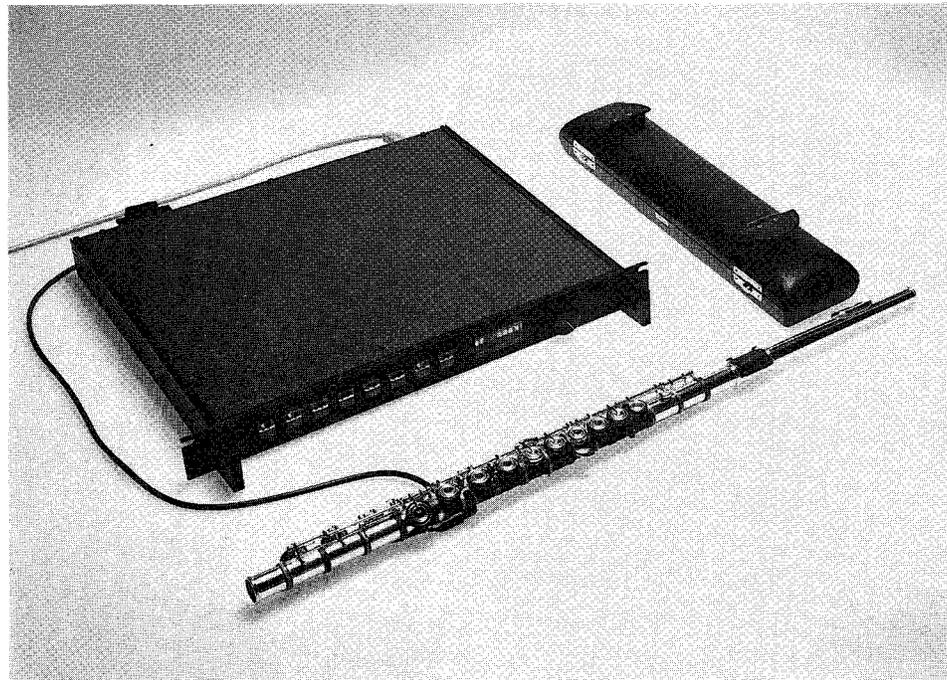


Figure 2 MIDI-flute at IRCAM

Congruences, pour ensemble et électronique "live" (1989).  
Commande de l'IRCAM.

Thomas Kessler  
Flute control, pour flûte et électronique "live" (1986).  
Commande de l'IRCAM.

Thierry Lancino  
Aloni, pour mezzo-soprano, ensemble, chœur d'enfants et 4 × "live" (1987).  
Assistant musical: Miller Puckette.

George Lewis  
Rainbow family, pour ensemble et électronique "live" (1984).  
Commande de l'IRCAM.

Magnus Lindberg  
Ur, pour ensemble et électronique "live" (1986).  
Commande de l'IRCAM.

Tod Machover  
Fusione fugace, pour 4 × "live" (1982).  
Assistants musicaux: Emmanuel Favreau, Marco Stroppa.  
Commande de la Biennale de Venise.  
Valis, opera pour solistes, bande réalisée par ordinateur, 4 × et électronique  
"live" (1987).  
Commande de l'IRCAM.

Philippe Manoury  
Zeitlauf, pour ensemble, bande réalisée par ordinateur et électronique "live"  
(1983).  
Commande de la Ville de Paris pour l'IRCAM.  
Jupiter, pour flûte-midi et 4 × "live" (1987).  
Assistants musicaux: Marc Battier, Cort Lippe, Miller Puckette.  
Pluton, pour piano-midi et 4 × "live" (1988).  
Assistant musical: Cort Lippe.  
La partition du ciel et l'enfer, pour flûte-midi, deux pianos-midi, ensemble et 4 ×  
"live" (1989).  
Assistant musical: Cort Lippe.

Robert Rowe  
Halls of Mirrors, pour clarinette basse et 4 × "live" (1986).  
Commande de Fonds de Scheppende Toonkunst.

Morton Subotnick  
The double life of amphibians, pour ensemble et électronique "live" (1982).  
Assistant musical: Stanley Haynes.  
Commande de Madame Pierre Schlumberger pour l'IRCAM.

Yucca Tiensu

P = Pinocchio?, pour ensemble, bande réalisée par ordinateur et électronique "live" (1982).

Assistants musicaux: Yves Potard, Jean-Baptiste Barrière.  
Commande du Centre Georges Pompidou pour l'IRCAM.

Balz Trümpy

Wellenspiele, pour piano, ensemble, et électronique "live" (1982).

Assistants musicaux: Niel Rolnick et Giuseppe di Giugno.  
Commande de l'IRCAM.

Michel Waisvisz

Touch monkeys, pour électronique "live" (1986).

Commande de l'IRCAM.

David Wessel

Contacts turbulents, pour saxophones et électronique "live" (1986).

Oeuvre réalisée en collaboration avec Roscoe Mitchell.



Figure 3 Boulez explaining some of the equipment after a rehearsal of *Repons* at IRCAM in L'espace de Projection