Directions de recherche actuelles en composition assistée par ordinateur

Projet EFFICAC(e)
[Extended Framework for In-time Computer-Aided Composition]

Jean Bresson
UMR STMS - IRCAM
Participants:

- Jean Bresson (IRCAM - Représentations Musicales)
- Diemo Schwartz (IRCAM - Interactions Musicales Temps Réel)
- Thibaut Carpentier (IRCAM - Espaces Acoustiques et Cognitifs)
- Florent Jacquemard (IRCAM - Représentations Musicales/Mutant)
- Dimitri Bouche (PhD, IRCAM - Représentations Musicales)
- John MacCallum (CNMAT / UC Berkeley)
- Rama Gottfried (UC Berkeley)

Thèmes abordés:

- Processus réactifs en CAO
- Structures temporelles dynamiques
- Interaction dans le contrôle de la synthèse et de la spatialisation
- Intégration de données et interfaces gestuelles
- ...

EFFICAC(e)

[Extended Framework for In-time Computer-Aided Composition]
OpenMusic

Computer-Aided Composition environment
Symbolic computation
Musical data structures


Visual programming language


http://repmus.ircam.fr/openmusic/
Specificity of the computer-aided composition approach

a.k.a. “what is the difference between OM and Max?”

"We conceive such an environment [of computer-aided composition] as a specialized computer language that composers will use to build their own musical universe. [...] This leads us to reflect on the various existing programming models, as well as on the interfaces [...] which make it possible to control this programming, and on the representations of the musical structures, which will be built and transformed using this programming."

Digital signal processing vs. symbolic music processing?


Computer-aided composition at the origins

Computer assistance in the exploration, processing and rendering of musical material
M. Puckette: A divide between 'compositional' and 'performative' aspects of Pd, 1st Pd Convention, Graz, 2004.
performance

composition
Programming / computation models

Real-time (DSP-oriented) systems:
- imperative dataflow
- continuous input/output (signal, events)

Computer-Aided Composition:
- functional / declarative style
- “out-of-time” calculus - static inputs/outputs

Computer-Aided Composition:

**FORMALIZATION ⇔ IMPLEMENTATION ⇔ SCORE**
OM visual program = symbolic representation...
- of a musical object/process
- of a compositional model
Describe intentions through a (computer) language
Time of computation vs. Time of music

In-time / out-of-time

A-series vs B-series
J. McTaggart. *The Unreality of Time* (1908)

[...] the major characteristic of Formes constitutes its weakness from our point of view; we think indeed that continuous and irreversible time, necessary for sound synthesis, is not the better paradigm for music composition in general. G. Assayag, Computer assisted composition today, 1998.

Contruction of temporal forms:
A few examples of CAC (from The OM Composer’s Book)

Ph. Leroux
VOI(REX) (2002)

Minimum Weight Spanning Tree
= optimal arrangement of the chords following a given classification criteria

Combinatorial optimization problems
G. Lorieux
*Langage de l’ombre*
(2006)
A. Schaathun

Double Portrait (2006)
Ph. Hurel / E. Daubresse

C. Jaksjo
*Undergrounded [Zoonestraal] I (2002)*
*Zoonestraal (2008)*
H. Parra
*Strette (2006)*
P. Linborg

TreeTorika

(2006)
... contruction of large-scale temporal forms

Applies in the sound processing domain too:

J. Bresson, M. Stroppa, C. Agon: 


=> Implementation of the compositional electroacoustic models and processes
- Symbolic approach/representation of sounds
- Musical sound formalisation
... construction of large-scale temporal forms (+ sound synthesis)

M. Schumacher, J. Bresson (2010) Spatial Sound Synthesis in
Time of computation vs. Time of music

(reactive) real-time systems
[Max]

(Transformational)
computer-aided composition
[OM]
where the distinction gets blurred...

Live coding

Computer improvisation systems

Score following

Impromptu

OMax

Antescofo
Toward a reactive computation model in OM

“demand-driven”


reactive

=> DEMO OM REACTIF
Toward a reactive computation model in OM

Staggered Evaluation. The previous framework leads to a staggered evaluation

$$\mathcal{E} : \mathcal{B} \times \mathcal{N} \to \mathcal{V},$$

where only the values of the boxes required to compute the outputs of $\mathcal{r}'$ are updated:

$$[b](k) =
\begin{cases}
  \ast & \text{if } b \notin \mathcal{B}' \\
  \mathcal{e}^i(b, k) & \text{if } \text{flag}^i(b) = \exists \\
  [b]^{-1}(k) & \text{if } \text{flag}^i(b) = \forall \\
  u & \text{if } \text{flag}^i(b) = \forall \\
  [b]_{k}(v_1, \ldots, v_m(b)) & \text{if } b \in \mathcal{r}' \\
  [b]^{-1}(k) & \text{otherwise}
\end{cases}$$

Figure 3: Call graph of the evaluation of $C$ in Fig. 1.

Figure 4: Propagation of event $\{R\}$ in the reactive patch from Fig. 1. We suppose that all boxes are active. Notice that $R \notin \downarrow \{R\}$: the values associated to $R$ are obtained by edition, not by evaluation.

applications / perspectives

Gesture devices and integration
(J. Garcia, D. Schwartz)

Controlled improvisation systems
(J. Nika / Improtek)

Control processes for granular sounds and spatialization
(T. Carpentier, R. Gottfried, D. Schwartz)
applications / perspectives

Interaction in larger-scale time structures / dynamic scheduling
(D. Bouche)

Dynamic/interactive control of tempo and rhythmic structures
(J. MacCallum, F. Jacquemard)